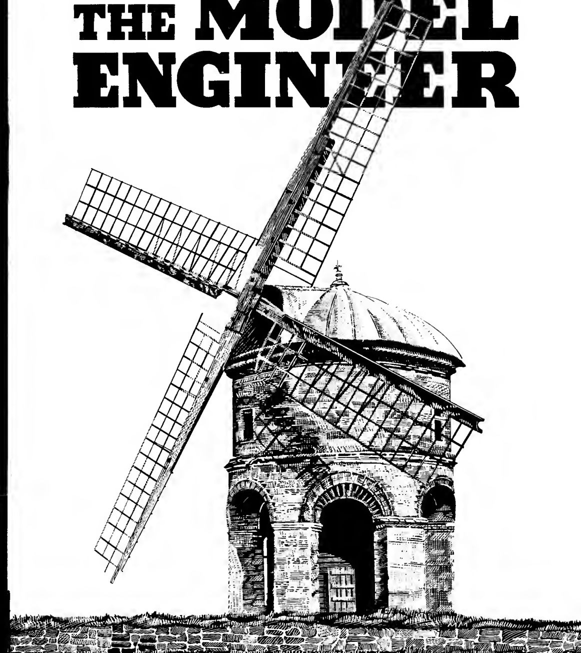
THE MODEL ENGINEER



Vol. 96 No. 2386 THURSDAY JANUARY 30 1947 9d.

THE
MODEL ENGINEER
Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2

SMOKE RINGS

Our Cover Picture

THE subject of our cover picture this week is Chesterton Mill, Warwickshire, six miles from Leamington Spa. A reader in Birmingham has supplied us with a number of interesting details regarding this mill, which is considered to be the most notable in Warwickshire, and one of the most striking mills in the country. From its photograph supplied to us with these details our artist has created this pleasing scraper board drawing. Chesterton Mill was erected in the year 1632 from designs by Inigo Jones, and in construction it consists of a barrel resting upon circular arches supported by six square and massive pillars. The mill had two floors, the top floor housing the grinding stones and the lower one being used for storage of grain. The mill machinery was all-wood construction, the driving power being conveyed from the sails by rope belts. Carts bringing grain to the mill would be backed or driven under the arches, thus being protected from the weather, and the hoisting of the grain to the upper floors was assisted by power derived from the mill's sails when in operation. The last occasion upon which the mill was used for its functional purpose was approximately 50 years ago, although the first floor is still used for storage of grain, and during the days of threatened invasion in the late war the local Home Guard unit contrived to build a very useful look-out on the top floor. We agree with our reader, who, when submitting the foregoing details, suggested that this mill would make a fitting subject for the model maker. Perhaps some of our other Midland readers could augment these notes with further details of construction, etc., which would help to this end.

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Progress at Portsmouth

I AM glad to be able to report a very considerable expansion of membership in the Portsmouth Society. In 1943 it had only twenty-five members on the roll; this modest number has now grown to 180. A very popular veteran is Mr. Juan Mendez, who has on two occasions gained honours at THE MODEL ENGINEER Exhibition for his beautifully made model guns. Although model ordnance is his chief interest, he has lately undertaken the restoration of a model of a royal yacht built by a naval petty officer 140 years ago. Another member, Eng.-Com. Harry Gage, R.N. (ret.), is a model railway enthusiast, and possesses an elaborate layout of Portsmouth town station with the local extensions to Fratton, Havant, and Cosham. As with many other societies in badly-blitzed areas, the Portsmouth members are hoping that in the re-planning of their city their need of adequate accommodation for a meeting room and workshop, and perhaps for a boating-pool and permanent railway track, will not be overlooked by the authorities. Apart from the value of such a society in encouraging handicraft skill and technical studies, its meetings form a popular centre of local citizenship, while its outdoor power-boating and track-running activities can be a constant source of attraction and entertainment

for hundreds of visitors and their families. Local authorities in other parts of the country are providing facilities for the model engineering and boating clubs in their areas and it is much to be hoped that Portsmouth, with its splendid naval traditions, will not miss this opportunity of becoming one of the best centres of model shipbuilding and engineering in the country. The Hon. Secretary of the Club is MR. H. A. HANDSFORD, 5, Milton Road, Copnor, Portsmouth.

The Shipwrights' Exhibition

ALL ship modellers and ship lovers will find a feast of good things awaiting them at the Royal Horticultural Hall, Westminster. This is the Exhibition organised by the Worshipful Company of Shipwrights and supported by all the leading shipbuilders of the country. It was opened on January 28th and will remain open until February 8th. Both halls are in use, the larger hall being devoted to shipbuilders' exhibits, and the small Hall to a display by ship owners. In addition to exhibits of all kinds relating to shipbuilding and marine engineering, there is a splendid array of ship models, many of them of great historic interest. Several valuable awards are offered for models, including three prizes of £100, £50, and £25 for the best models of the "Ark of Noah." A number of papers will be read and films shown in the lecture and cinema hall during the exhibition, to which visitors will be admitted free. Admission to the Hall will be 1s. from January 30th.

The "M.E." Speed-boat Competition

WE regret we have had to fly the signal of "No Race" in regard to our 1946 speed-boat competition by reason of the scarcity of entries. There were plenty of good intentions among speed-boat men, but only two entries actually reached us by the closing date. Though these were both very creditable performances there were no new records, and we felt it would be better to regard the competition as being in abeyance for the time being. We are sending a small honorarium to the two competitors in acknowledgment of their efforts, and, as the competition will be open again for 1947, we shall look forward to a more representative set of entries when this year closes.

Making the Workshop Pay

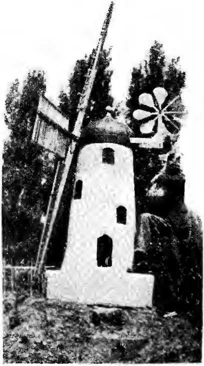
A RECENT letter on my desk is typical of queries which from time to time I am asked to solve. My present correspondent is a trained engineer with a well-equipped home workshop, who, for private reasons, finds it desirable that he should endeavour to make a living under his own roof rather than again take up factory employment. He has already adventured into toy making, but finds a difficulty in the shortages and control of materials. What would I advise him to do in order to make, not a fortune, but just a modest living? While history tells us that some very important engineering or manufacturing concerns have taken rise from extremely modest beginnings, I hesitate to advise my correspondent to go in for quantity production of any range of tools or engineering supplies. His main asset is the skill of his own hands, and any endeavour to go in for manufacturing will bring immediate claims on his time and his pocket which will prevent him from using his skill to the best advantage. These may be briefly indicated as the purchase of materials in sufficient quantity, the making up and financing of stock, the correspondence and book-keeping involved, and last but not least, finding a market for the goods he makes, an item which may call for travelling, price lists, advertising, and other outlets for both time and money. He will, in fact, become so absorbed in his effort to build up a business that he will have little or no time to turn his workshop skill to productive advantage. I have at times known cases of first-class mechanics who have thrown up a good factory job in order to become their own masters, a very attractive proposition, but one surrounded with pitfalls for which they have not bargained. Some of these I have already indicated; there are others such as rent, rates, heating and lighting, wages if they employ other workers, office expenses, the upkeep of workshop equipment, and other overhead costs, all of which are strange ground for the working mechanic and quite likely to bring his enterprise to a standstill unless he has a flair for business management, unlimited energy, and a liking for long hours. Some men have been successful, but these I think are the exception rather than the rule. I suggest that my present correspondent, and others in like circumstances, should rather look for some more individual line of action in which their manual skill and technical experience could be definitely applied. This may take the form of model-making for private customers, the making of models and experimental devices for inventors or for exhibition purposes, or the execution of repairs to the multitude of mechanical appliances which are to be found in any populous area. Clocks, sewing machines, cycles, mangles, mincers, coffee-roasters, lawn-mowers, dairy appliances, cameras, motor-cars, and dozens of other kinds of light domestic and trade machinery want minor repairs and replacements which the skilled home-mechanic could effectively carry out. The customers, of course, want finding, and the would-be home worker must let as many people as possible know that his tools and skill are available whenever required. He must explore the district, leaving his card here and there, and get himself known by his work and his prompt service. If he has a cycle he could spread his fame afield among farmers and other isolated residents wherever there is a machine or appliance which is likely to need an overhaul or a new part. In time work may come to him unsought, but in the early days he will need to be enterprising and make himself known. In taking on work of this kind the home mechanic may use his skill to full advantage and even if he does not make a "pile," he may find it possible to have agreeable occupation and keep the wolf from the door.

Percival Marshall

WINDMILL EXPERIENCES

By

F. K. Hinton



INSPIRED by recent photographs and articles of windmills, and also having been a very enthusiastic reader of THE MODEL ENGINEER for a great number of years, and, may I add, not having contributed a photograph before, I could not resist the urge to compile a few brief notes on my experiences in modelling mills.

My first effort was a scale model of my grandfather's water-mill, $\frac{3}{4}$ in. to 1 ft. The high breast wheel of the original was 16 ft. $\times$ 4 ft. 6 in. All details of the interior I reproduced, including the two pairs of mill-stones, governors, flour dresser, bag hoist, etc., with all the wooden bevel gears and mortised wood teeth faithfully reproduced, after having made drawings from the original.

Difficulties

Not being in possession of a lathe of any description, you can easily imagine my difficulties. The most difficult part was the main water-wheel shaft of splined section, which was overcome by drilling a series of $\frac{3}{8}$-in. holes along the sides of a piece of square section steel and chiselling and filing away the intervening metal. The model machinery is enclosed with detachable walls representing brickwork, and when connected to the tap the wheels clatter round in a most realistic manner by just a trickle of water. Three years of spare time was devoted to this work.

A scale model of Tuttle Hill windmill, Nuneaton, was my next effort, built to the same scale. This was a unique windmill, since it was driven with five sweeps, instead of the usual four, with automatic weight-loaded shutters to each sweep, connected with a push-rod through a hollow shaft. The 140 shutters were made from 3/64-in. plywood, and each pivoted in tiny brass bearings, which open and close with the aid of two wires, the length of each sweep connected to five bell-cranks (cut from solid brass) mounted on the hub.

The tail-wheel is back-geared and winds the whole roof and top-hamper round the toothed track secured to the top of the miniature building, trimming the sweeps to the wind.

The interior machinery is driven through a vertical shaft of $\frac{5}{16}$-in. silver-steel with a small gear at the top and reaching down to a cup-bearing on the ground floor. The whole structure is built on a rigid oak frame, to allow the interior machinery to work when the cone-shaped walls are removed to allow visitors to view.

The job occupied about two and a half years of leisure time.

A Permanent Structure

Living on a hill with an exposed garden, I decided to build a permanent windmill to work a pump for circulating the water of my fishpond. The mill depicted in the photograph was built of reinforced concrete, with the spring-loaded sweeps and tail wheel turning on a large starter-ring taken from a commercial vehicle. The whole is surmounted with a roof made from scraps of copper strips soldered together on a plywood jig. Very easy turning for the tail-wheel is obtained by mounting the roof framing on old roller-skate rollers, and the horizontal shaft on ball-bearings. Each sweep shutter is spring-loaded and opens and closes according to the velocity of the wind. The twist of each sweep is obtained by setting the frame of each at 25° at the hub to 9° at the tip ; *this is important.* They make an arc of 9 ft. and very fascinating to watch when a gale is blowing. The weight of each is about $5\frac{1}{2}$ lb., lightness of building being very important.

The building, which weighs $7\frac{1}{2}$ cwt., is erected on a brick-built well sunk 7 ft. down, comprising the sump for the diaphragm pump to work.

MODEL ENGINEERING OVERSEAS

JUST before war broke out, in June, 1939 to be precise, I left England in the P. & O. liner *Canton*, for a tour of duty in Aden. I had to leave behind my workshop and my stud of racing cars; I did, however, take with me a small selection of hand tools, as I was determined not to drop model engineering altogether; little did I realise then what I should see happen in the world before I got home again.

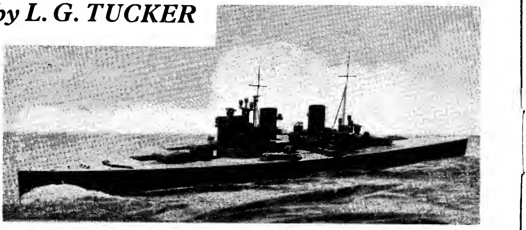
In Aden I found that the climate was all against model engineering; not only did the heat and humidity discourage such work, but one's hands were very easily blistered when using tools, and a cut or a blister needs far more care in that climate than in England. I did, however, do a few jobs chiefly connected with my camera, newly obtained direct from Germany, making an ever-ready case in leather for it and another leather case to carry such accessories as the telephoto lens.

After about eight months I was transferred for health reasons to Malta and arrived there not very long before Italy declared war. I set up a small workbench in the private sitting-room which I was fortunate enough to procure in the hotel and set to work in earnest. In quite a short time I had produced a photographic enlarger and a gramophone attachment for my radio set. The former was constructed chiefly of $\frac{3}{8}$-in. plywood, with a tinplate casing for the lamp; the lens came from an old camera, bought cheap second-hand, and had a focal length of 3.75 in. and an aperture of *f*/4.5; the 4-in. condenser was sent out from England. For the radiogram I built a wooden case to fit under the radio set itself, with the electric motor and pick-up mounted on a board so arranged that when the front of the case is pulled open the board slides forward, bringing the turntable into a suitable position for putting on or changing a record; the electric motor with turntable was bought locally and the pick-up had been bought in Aden, where it had been rigged up on a portable gramophone; the radio set is a Philips specially built for use in the tropics and covers all wave-bands; it is an extremely powerful set.

At about this time Italy declared war and the famous series of air-raids started; I left the Valletta district for the country, packing up my tools and belongings once again; it was not until some months later that I moved back into the Valletta district again and could get out my tools; I used a small table in my hotel bedroom as a bench and worked under difficulties.

Both in Aden and in Malta I had seen much of the ships of the Royal Navy and decided to build a model warship; I chose as a prototype H.M.S. *Hood*, selecting a scale of $\frac{1}{16}$ in.-1 ft., which brought out the length to about 4 ft. 6 in.; I had no proper plans, but was able to refer to Janes' "Fighting Ships"; the hull I designed carefully, using the wave-line theory for obtaining the cross-sectional areas; I had used this system before when building a canoe (full size) and had been impressed by the very easy running with little effort, up to a certain critical speed (critical speed = V in m.p.h. = $\sqrt{L/.72}$, where L = length on waterline in feet). Beam and draft were kept very near to scale, as I much dislike the appearance of a model when these proportions are increased more than a very little; to my mind far too many models, which are otherwise beautifully made, offend in this respect. I did manage to increase the displacement a bit by giving the hull slightly fuller lines fore and aft, and later realised that I had rather overdone it, but the

by L. G. TUCKER



general appearance of the hull was fairly satisfactory. The displacement was 20 lb. It was built on the usual bread-and-butter system out of deal planks, the only wood I could obtain at the time, glued together with casein glue and then sewn together with thin copper wire. The deck and all the upper works were made entirely of wood, chiefly $\frac{1}{8}$-in. thick pine, except for a few of the fittings like the funnels, anchors, anchor-chains, etc. I did not attempt to put in too much detail, but merely to include enough to give the general impression of the prototype; no propulsion plant was made, owing to lack of materials and tools, but the whole job was planned as a working model, and steam plant was to be added fitted forming water-tight compartments fore and aft, and also dividing up the remainder of the hull into sections; it was built upside down with the bulkheads held in position on a baseboard and the ribs similarly positioned on temporary rough wooden shapes. The stem was built as in normal wooden shipbuilding practice, but the stern was a solid block of wood carved to shape inside and out. The planking was about $\frac{5}{8}$ in. wide amidships and each piece was shaped to fit, being, of course, tapered towards each end; each was nailed to every rib and screwed to every bulkhead, stem post and stern. The hull was afterwards well rubbed down and painted. The topworks were made removable in sections, and were again

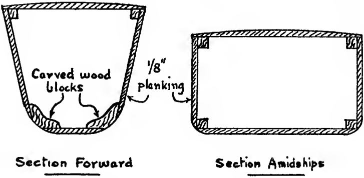


Fig. 1. *Sections of "J" class destroyer*

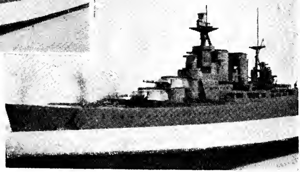
later. The funnels were made from old cocoa tins, the anchors from odd bits of metal and wire, and the anchor-chains from copper wire bent to shape (R.N. pattern) on a small jig.

After completing the *Hood*, I started on a "J" Class destroyer to a scale of 3/32 in.-1 ft., giving a length of $32\frac{1}{2}$ in., with a beam of $4\frac{1}{8}$ in. and a draft of $1\frac{1}{2}$ in. This hull was built from bits of $\frac{1}{8}$-in. mahogany, with a flat bottom from amidships aft, but shaped forward by the inclusion of a wood block carved out inside and shaped outside.

The deck was a piece of duralumin sheet aircraft scrap, the funnel was built up of tinplate with a shaped base, and the remainder of the fittings were chiefly of thin wood to keep the weight to a minimum. The weight of the hull complete was 2 lb. 4 oz., leaving approximately a similar amount available for the plant to bring up the weight to the designed displacement.

I then got ambitious and tackled a model of H.M.S. *King George V*, again to a scale of 3/32 in.-1 ft. Very few details were available, and I had never seen the ship; however, with the aid of some newspaper photographs I got out the plans; hull 6 ft. 3 in. long × 10 in. beam × 3 ft. draft; these were correct to scale as far as I could ascertain, and the lines were fairly fine; displacement worked out at 45 lb., and the final weight of the model, minus plant 15 lb., leaving 30 lb. to play with; I planned to have steam propulsion with twin screws (this applied to all these models) and found that I should also have room and weight to spare for radio control, of which more anon. The hull this time was constructed of $\frac{3}{16}$-in. thick pine planking nailed to ribs, some bent, some sawn, to shape; bulkheads were chiefly of wooden construction, but the deck over the boiler and engine space was of sheet duralumin from a Junkers 87 I had seen shot down. The seaplane hangars formed admirable vents to allow of air being drawn in for the blowlamp firing the boiler; this question of vents had caused some difficulty in the two previous models; in the *Hood* the whole of the mainmast structure or control tower was made hollow and at each deck level in the control tower there was a small vent connected to the central hollow shaft; in the destroyer I put vents in as many of the topworks as possible and managed to make them inconspicuous.

In the case of *King George V*, I put in rather more detail than in the previous models, and managed to include not only the main and secondary armament, but also the multiple pom-poms, rocket projector, searchlights (used revolver cartridges), range-finders, launches and whalers, etc. I also started on two Walrus seaplanes with folded wings, but gave them up as a bad job. The two lattice-work derricks for lifting the seaplanes aboard were conspicuous in the prototype, and so had to be attempted; I bent up some thin tinplate into angle-iron form, each side being about $\frac{1}{16}$ in. wide; four of these went into each derrick and the lattice-work was formed out of lengths of 20-gauge copper wire bent to shape round a piece of wood the size and shape of the derrick; the whole lot was then tied round with thin wire and soft-soldered; the piece of wood inside was cut away bit by bit through the lattice-work; after cleaning up, it looked quite realistic; very crude construction but effective.



Two views of the model H.M.S. "Hood"

The idea of radio control gave plenty of room for thought, and it was not until a year or two later that I hit on what seemed to be a good scheme which overcame the various snags. I read an article on radio control of model aircraft which described a most ingenious method of using a telephone selector dial as the main control; you simply dialled the number of the control that you wanted and as long as you kept the transmitter switch down that control continued; directly you lifted the switch the selector gear in the receiver automatically returned to zero and another control could be dialled immediately; every control always retained its own number; included in the design was one set of controls worked by a split-field electric motor, which could be rotated in either direction according to which of two controls was dialled (*Aeromodeller*, December, 1942). I decided to use two of these motors in my design, motor A for working the reverse gear of the steam plant and the steam regulator, motor B for working the helm. Each motor was to drive through a worm gear with the ratio so arranged that it would take some 4 or 5 sec. to run the control from its neutral position to its maximum in either direction. Motor A, starting from its neutral position with control No. 1 on, would first put the valve-gear into forward position and then slowly open the steam regulator; or with control No. 2 on would work in the opposite direction and cause the engines to go into reverse. Motor B, dependent upon whether control No. 3 or No. 4, was dialled would give port or starboard helm; and would leave the helm in that position until another control was dialled for alteration of the helm. So you could dial No. 1, say, for 2 or 3 sec., release the transmitter switch (ship now half-speed ahead), dial No. 3 for 1 sec., and thus give a little port helm, and so on.

Other controls up to a total of ten could be arranged to sound the ship's syren, work the guns, etc. A modification which might be necessary for both motors is the inclusion of a third control for each; the use of this would be to cause the motor to revolve back to and stop at its neutral position, i.e. motor A to put the valve-gear in mid-gear with regulator closed, and motor B to put the helm in the straight ahead position. I believe that this modification could be made and that it might make for easier control. I have not, unfortunately, been able to try out either system.

In about November, 1941, I commenced building a fourth model, H.M.S. *Manchester*, a ship I had seen many times and the first that I had been aboard; she has, alas, since been sunk. She was one of the three ships of the same class forming the East Indies Squadron based on Aden in 1939, and I shall always remember how, on September 3rd, 1939, an hour or so before war was declared, I was standing on a verandah overlooking the harbour when one of these ships, it was the *Manchester*, I think, steamed in; suddenly from the fort just behind me came an ear-splitting explosion as a heavy gun was fired; the shell hit the water only just ahead of the cruiser and narrowly missed a cargo boat lying at anchor as well; there had been some confusion over the answering signal given to the shore station and a warning shot had been fired. There was a lot of good-humoured banter afterwards. But to get back to the gentle art of model making. The scale was again 3/32 in.-1 ft., and the length of the hull was 5 ft. 8 in., with a beam of 6 in. and draft of $2\frac{1}{4}$ in. Obtaining some very nice mahogany boards, $\frac{7}{8}$ in. thick, I again used the bread-and-butter system; the hull was drawn out and every plank was cut and carved to shape on the inside, and roughly cut out on the outside before gluing together. I was thus saved the work of any great amount of trimming inside the hull afterwards and merely had to carve the outside to shape to template; apart from the

deck's funnels and main topworks, I did not have time to complete this model, and still hope to do so one day, as the lines of the hull are very fine, and she should have a good turn of speed; she will need a power plant with a low centre of gravity on account of the narrow beam.

All these models were built in odd moments, chiefly in the evenings, and after a strenuous day (most people on the island led a fairly hard life at that time) I found that the relaxation afforded by this model work an immense help. The last model was built almost entirely during raids which were nearly continuous at that time, and I infinitely preferred to stay up in my bedroom doing such work to sitting down in a shelter listening to the racket outside; and I found myself far better fitted for work the next day. Eventually things did get too hot, and, as I was due to return to England quite shortly, I packed up, putting the models down a good rock shelter. I did not see them again until I had been back home for some months, when they turned up with the rest of my baggage, having had a very adventurous journey through the Mediterranean. For myself, I had come back in comparative luxury by B.O.A.C. Catalina *via* Lisbon, Foynes and Poole, where I landed on May 5th, 1942; never was I so glad to see the green fields of England again. I often look back on those grim days of 1940-42, and am thankful that I had my hobby to give me relaxation and pleasure. Since my return I have taken up the building of small locomotives, about which the Editor may perhaps let me write one day.

I mentioned earlier in this little story the wave-line theory for hull design, and perhaps a few notes on it as I understand it would be of interest. I set down on my drawing, full size if possible, a horizontal line equal in length to the waterline length of the hull; I then add on at each end an additional length equal to about 7 to 9 per cent. of the W.L. length at the bow end and about 5 to 7 per cent. at the stern. In Fig. 2 I have tried to make this clear.

Then, dividing this total length of line in the proportion of 7 (bow) to 5 (stern), I fix the position of the midship section at 7/12 from the bow; at this point I set up a vertical line and, using a convenient scale of X in. = 1 sq. in., I mark off on the vertical line, measuring up from the base-line a distance equivalent to the immersed cross-sectional area of the midship section of the hull. In a square-shaped hull section, this area is, of course, equal to beam X draft, less a small amount for the rounding of the bilges. Draw a circle on this vertical line as diameter and set out for the bow section a versed-sine curve, and for the stern section a cycloidal curve as shown in Fig. 2, but preferably dividing the circle and the base-lines into a larger number of parts. The bow and stern sections are also known as fore-body and aft-body respectively. Measuring up from the base-line to this curve at any point will give the area of the immersed cross-section at that point, using the same scale, X in. = 1 sq. in. One small matter for care is to choose this scale so that the height of the vertical line is about 0.75 to 1.00 of the actual beam, e.g. with a hull of beam 8½ in. and draft 4 in., area = say, 32 sq. in., a suitable scale would be 4 sq. in. = 1 in., and the vertical line would be 8 in. high. I have never been able to obtain any definite rule as to what scale to adopt and the above suggestion is based on my own ideas on the subject. At extreme bow and stern it will be seen that the values obtained are very small and only become appreciable within the actual water-line length as distinct from the theoretical water-line length; this reduction of length at each end does not, according to reliable information, materially reduce efficiency, and it certainly does make for easier construction, and avoids the very fine lines which would otherwise be required at bow and stern.

The lines of the hull are then drawn out and the cross-sectional area checked at points every 3 or 4 in. along the length of the hull; they should coincide with the values obtained from the displacement curve as detailed above and the lines

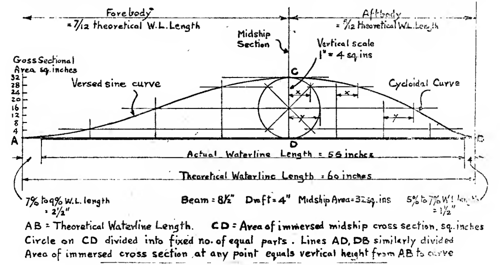
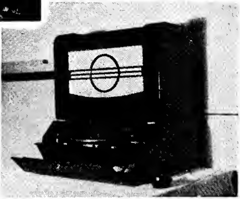


Fig. 2. Waveline theory for model ships

Left : Gramo. cabinet, showing turn-table pick-up, etc.
Below : The radiogram shown open



must be altered by trial and error until they do coincide. If the cross-sections are drawn on squared paper the areas can be quickly found by counting up the number of whole squares plus the squares which are more than 50 per cent. whole within the hull ine and omitting those which are less than 50 per cent. within ; or a planimeter may be used if you have one. The total displacement can be found in several ways, one of them being to multiply the water-line length by the area bounded by the displacement curve and the base-line, this giving the answer in cubic inches of water displaced ; the area must, of course, be worked out, using the vertical scale of X sq. in. = 1 in. The water-lines, cross-sections, and buttock lines should all be smooth curves when you have finished ; it may take a little time to achieve this state of affairs, but I believe it is well worth while. For the lines above the water-line, I run these up in smooth curves to meet the deck line generally giving a nice flare at the bows. This system does not, of course, touch upon the question of stability, but I am not unduly concerned over this, since, if a rectangular section is adopted amidships and the ratio of beam to draft is kept between, say 2 : 1 and 4 : 1, I can see no cause for worry. And it is possible to get a very nicely-shaped hull even with this rectangular midship section. The wave-line theory can be applied to other shapes of hull as well, and is not in any way restricted to the shape of hull I have endeavoured to describe ; I have merely selected a type which is easy to design and construct and which is found in most prototypes.

For the Bookshelf

Model Diesels, by D. J. Laidlaw-Dickson, edited by D. A. Russell. The Harborough Publishing Co. Ltd. Price 7s. 6d.

Since the cessation of hostilities and the release of information concerning the miniature compression - ignition engines developed on the Continent during the war period, considerable interest has been created amongst modellers in this country concerning the possibilities of this type of engine for all purposes where a high weight per horse-power ratio is required.

The book under review provides a comprehensive catalogue of engines which have appeared on the Continental and British markets up to the time of publication and will be of considerable interest to those embarking on the design and construction of this type of engine, provided he uses his own common sense and does not take all the statements made (historical and technical) as being fundamentally correct. For instance, one is left with the impression that the compiler of this book is not quite clear on the definition of such terms as pre-ignition, detonation, and ignition lag.

The chapter on fuels is provocative but inconclusive, and indeed could not be dealt with adequately in the space devoted to it. Much more practical is the tabulated page of fuels recommended by the various engine manufacturers.

The book nevertheless contains much to interest those who are already intrigued with the possibilities of this type of engine and it should prove particularly useful to the tyro who wishes to become familiar with the " why and wherefore " of this type of motive power.

*The Story of a Petrol Engine
by J.L.

AFTER the Armistice, the engine was found to be in fairly good condition when the grease and dirt had been washed off it, and after my workshop was set up once more, a new crankshaft was put in hand.

My experience with the R.F.C. during the war had taught me a bit about alloy steel, and my work at that time being connected with a drop forge, I had no difficulty in obtaining any sort of steel I wanted. I had a small forging made in vanadium-chrome, with a test piece on one end so that I could be sure that the heat treatment was right. As far as I remember, the tensile came out about 50 tons, and the Izod was in excess of 110 ft./lb., so I felt pretty sure that it would never break under fair usage.

It didn't get fair usage on many occasions since, but it never broke, and is in the engine to this day.

The diameter was increased to ½ in., which was as big as the crankcase bushes would allow boring out to. A new and somewhat heavier mild-steel flywheel was also made and fitted, and the engine ran once more and drove the dynamo for odd jobs of accumulator charging and the like with fair success, but overheating due to the uncooled head and lack of a proper oiling system limited its usefulness. For some years it lay idle, as my model engineering activities took a different direction.

About the mid-'twenties I again had to move my workshop, and at the same time I disposed of the Drummond lathe and bought a 3¾-in. Milnes. I kept the Drummond treadle as a stand-by, but as I was now getting lazy, I planned for a power drive for the tools and, although I considered an electric motor, I thought it might be a good idea to utilise the petrol engine for the job, especially if it could be brought up to date a bit; so the old engine was cleaned up and set to work, and a start made with the improvements.

The first thing to be made was a new connecting-rod, as on every occasion on which the old rod was examined the big-end bolts were found slack; this was not to be wondered at, considering that they were only ⅛ in. diameter and made of soft mild steel, for they would hardly bear tightening up without stretching.

I enjoyed making the new rod, as it was the first real trial of the new Milnes, and it fully came up to expectations.

The material used was chrome steel, as for the crankshaft, and as space for the big-end in the crankcase was rather limited, I dispensed with the previous split brasses, and used white metal run direct on to the rod; this allowed of a rather more generous size of big-end-bolts.

This rod, and the machining involved, was very fully described in an article in THE MODEL ENGINEER in November, 1927.

A little experience soon showed that the engine was not ideal for the job; it needed a governor to keep the speed constant, and the necessity of looking after the battery for the coil ignition was very tiresome.

The old dynamo had been given in part exchange for a 150-watt machine made by Thompson, of Greenwich, and this was kept permanently belted up to the engine so that one of the two accumulators would always be on charge; however, it occasionally happened that on coming back after an absence from home, the batteries were found to be flat, and therefore the engine could not be started without a lot of bother.

Previously, the excuse for the dynamo was that it was needed for the wireless batteries, but after getting a trickle charger, there was no need for it on this account and I began to look around for a magneto.

I managed to pick up an old single-cylinder Fellows, and this was mounted on a wooden block, so that it lined up with the camshaft, and was driven by a flexible fabric disc coupling.

A governor was also contrived, similar to that used on gramophones. This was mounted on the head and had a belt drive from the magneto coupling, but was not very successful owing to defects in the carburettor.

If a sudden load was thrown on the engine, due to starting up the lathe with a heavy job on the faceplate, which took some power to accelerate, the governor yanked the throttle open to the point where there was a very pronounced flat spot in the carburettor, and the engine ignominiously came to a standstill, unless you rushed to the throttle and closed it a trifle, to allow the engine to pick up.

The only real cure for this was a better carburettor, so the old Longuemare was scrapped and

* *Continued from page 119, "M.E.," January 23, 1947.*

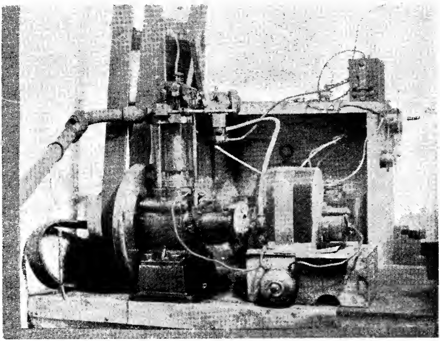


Fig. 7. The engine about 1928. A photograph taken after stripping the timing wheels

a new one designed on the lines of Westbury's "Atom." After this was made and fitted, the engine responded perfectly to the governor.

About this time I began to take a more serious interest in petrol engine design, and rigged up a rough friction brake to see what power the engine would give. The results were 0.32 h.p. at 800 r.p.m., 0.35 h.p. at 1,000, and 0.42 h.p. at 1,400.

These figures were obtained with the engine cool; they fell off considerably if it ran at full throttle for any length of time, as was only to be expected with the lack of cooling on the head. They correspond to B.M.E.Ps. of 40-50 lb. per sq. in., which, though low by present standards, are normal for automatic inlet valves and a compression ratio of 4/1.

Shortly afterwards, a new cast-iron cylinder was made and the old piston reduced slightly to fit; this new cylinder, being slightly shorter, gave a compression ratio of 5/1, but before any further tests could be made to try the effect of the increased compression, a tooth broke in one of the timing wheels, and chewed up all the timing gear. This accident was probably due to the extra load thrown on the gears by the magneto. The gears themselves were not the original brass ones, but a steel and cast-iron pair which were made at the time the second crankcase was made; possibly there was a slight flaw in the cast iron.

The fitting of the new cylinder was a landmark in the engine's history, as with the scrapping of the old one, the last portion of the original engine disappeared; everything had gradually been replaced or renewed, and still further changes were contemplated.

As the lathe now had to revert to treadle drive, pending repairs and alterations, I seriously considered getting an electric motor and scrapping the engine, as I had no real reason for fixing it up again, unless it was to drive the workshop.

However, having done so much to it, I thought that it was a pity to discard it, and I decided to rebuild it entirely, with a view to making it reliable and quiet, and still using as much of the existing material as possible.

Drawings were therefore prepared for a new cylinder-head, with mechanically-operated valves and a sturdy pair of rockers on long bearings to reduce wear and noise. The head was not water cooled, nor was it finned. I would have liked to arrange for some sort of cooling, but I felt that my pattern making was not equal to the complexity that would be involved.

No doubt this was not a very sound decision to make, but as the engine normally ran very lightly loaded, I was not afraid of serious overheating.

The main factor in making the engine mechanically quiet was a well-designed timing gear. The old wheels being completely exposed, and the cam a roughly-filed-up affair of no particular shape, it was not to be wondered at that the clanking of the valve gear was heard above everthing else.

A fully-enclosed camshaft, driven by a pair of spiral gears, was decided upon, the whole enclosed

in a heavy cast-iron housing, bolted to one side of the existing crankcase. One end of the camshaft drove the magneto through a flexible fabric coupling, while at the other end was mounted a centrifugal governor, somewhat on the lines of a design by Mr. Westbury.

The spiral gears could have been cut reasonably cheaply by an outside firm, but I felt that it would be interesting to cut them in the lathe with the milling attachment; the job was described in THE MODEL ENGINEER in January, 1933.

Cams

The cams, which operate flat-base tappets, were generated as regards the flank profile by a rather complicated method, which I also described at the time, but I would not advise making them that way now, as it is longer and not really so accurate as the milling method which has been fully explained by Mr. D. H. Chaddock.

However, as the engine is only a slow-speed one after all, the cam shape is not very critical, and the cams that were made gave reasonably quiet running.

To support the magneto, a cast-iron bracket had to be made, and this was sandwiched between the bottom of the crankcase and the box bed which supports the whole engine and raises it sufficiently for the flywheel to clear the ground.

While the engine was stripped for these alterations, the opportunity was taken to replace the crankshaft bushes, and turn down the flywheel end of the shaft to a taper to fit the new flywheel.

The new flywheel was very little heavier than the one it replaced, but a considerably larger diameter was possible, owing to the raising of the engine due to the sandwiching in of the mangeto bracket. No key was fitted, the carefully-fitted taper being relied on to hold.

All this work took me some months, and as I was reduced to leg power for the lathe until the job was complete, I was not sorry when the time came to erect the engine again.

The first trial was voted a great success, as the engine really was quiet except for the suck of the air to the carburettor, and even this was reduced a bit by fitting a cap.

A Brake Test

As soon as everything was adjusted and running properly, a rough brake test was made to see what difference the new head had made to the power. I have mislaid the exact figures, but I remember that the maximum B.M.E.P. was about 90-95 lb. per sq. in., which was almost double the previous figure, and as it was well sustained as the speed increased, the maximum horse power was now more than one.

Naturally, with the uncooled head, these full throttle powers could not be held for long, but as the engine was never called on to exert itself to this extent in normal circumstances, overheating has never been a problem. The only item of workshop equipment that caused the governor to open the throttle as far as halfway being the grinder, which can take a good deal of power when grinding up a heavy tool or when doing a bit of rough work.

During the next few years, various other small additions and improvements were made. As the engine was bolted to the bench and not to the floor, there was a certain amount of vibration at high speed, and this was reduced by fitting a pair of bronze balance weights to the crank webs and lightening the piston somewhat, by turning away metal from the inside.

A Burgess-type silencer was also made, and although this did not make much noticeable difference inside the shop, it reduced the noise outside, and removed a possible source of neighbourly complaint.

A useful improvement was an additional spring on the governor, which could be increased in tension, as required, by a Bowden control. This enabled the governed speed of the engine to be altered as desired between about 750 and 1,500 r.p.m., without leaving the lathe.

The lack of this facility for an extra high speed when desired was my first complaint when the electric drive was installed recently, and no cheap and easy way of regaining this lost advantage has suggested itself to me at the moment.

All exhaust joints were very carefully made, so as to avoid any leakage into the shop, but as there was a certain amount of smell from the crankcase breather, this was blanked off, and a small copper pipe led from the camshaft housing to the carburettor intake; the engine thus consumed all its own smoke!

Doing its Duty

When I moved to yet another workshop in the early 'thirties, the engine was reinstalled on a concrete base on the floor, where it continued to do its duty as needed until a few years ago, when the workshop was closed down owing to the war.

During the final stages of its life it gave surprisingly little trouble, and was very economical of fuel. The actual consumption was never measured accurately, and would not be much of a guide in any case, as to how long a tankful would last, as this depends greatly on what is being done in the lathe.

Starting was always accomplished by a pull on the belt, and when the engine was warm, a single pull sufficed. For a cold start, it was better to flood the carburettor slightly, when it would generally go at the first or second pull. In fact, starting was so easy that the switch was snapped off if the lathe was left for more than 30 seconds.

Decarbonising was carried out only when lack of power made it essential. The engine never had a really proper oiling system, and, naturally, was sometimes over-oiled, so that carbon collected fairly quickly. This in itself had not much effect, but when the amount of "coke" was considerable it would get a small piece on the exhaust-valve seat and cause a loss of compression and considerable reduction in power.

As the power available was generally ample, it was generally left to run in rather a leaky condition for some time after the first symptoms were apparent; as decarbonising is always rather a dirty job, and one I am not fond of as a rule. However, when one did make up one's mind to tackle it, it could usually be finished in an hour, and the engine was then good for about another twelve months.

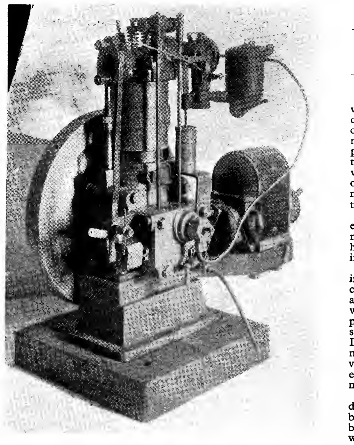


Fig. 8. The engine as it is today

The oil scoop for this bearing was formed from a piece of sheet copper, which also served as a combined tab washer for the two nuts on the big-end bolts. The projecting piece which formed the scoop had broken off, due to weakness or corrosion, or a little of both, so it was replaced by a more solid piece silver-soldered to the cap.

This was the first time the engine had been stripped for a number of years, and I was horrified at the filthy condition inside.

The crank was churning round in a sort of black paste formed of condensed water, oil and carbon; and the fact that it was corrosive was evident by the amount of pitting on the one-time bright surfaces of the crank webs, etc. It was a striking example of the necessity of adequate crankcase ventilation, especially on an engine which is run only intermittently.

I had some thoughts of drawing the air for the carburettor through the crankcase, but as I was busy on other work at the time, and wanted the engine in commission as soon as possible, decided that after a good clean-out it would probably run another five years or so without trouble, and so it proved.

In gratitude for long and faithful service, I should strip her down once more and clean everything up, and I hope to do this in the near future. Meantime, her exterior has had a bath of paraffin and a wipe-over, and she stands in the corner, where she can keep an eye on her electrical successor, which I hope will give the service the old engine did.

The oiling arrangements were pretty crude, but as the load was usually low and intermittent, very little trouble was experienced, and I never felt that it was necessary to arrange anything more elaborate than a plain glass sight-feed drip to the crankcase, where everything was looked after by splash.

A year or two before the war, a knock developed, and when the crankcase was opened up to investigate, the big-end was found very slack, and the white metal disintegrating.

To Save Broken Taps

GET a piece of mild-steel strip or brass, approximately 3/32 in., or $\frac{1}{8}$ in. by $\frac{1}{4}$ in. about $1\frac{1}{4}$ in. long, make a square hole in the middle of it to fit the square end of tap and fix strip to tap with a touch of solder, and use it as a wrench.

I have had a set of $\frac{1}{16}$-in. Whit. taps so fitted some years without breakage, and now fit a similar gadget to all small taps up to 5/32 in., making the strip of a size proportionate to the tap. The advantages seem to be that each tap has its wrench in readiness, and the leverage is more proportionate to the size of the tap.—C. V. BAVIN.

A Clepsydra, or Water Clock

By W. W. Ottewill

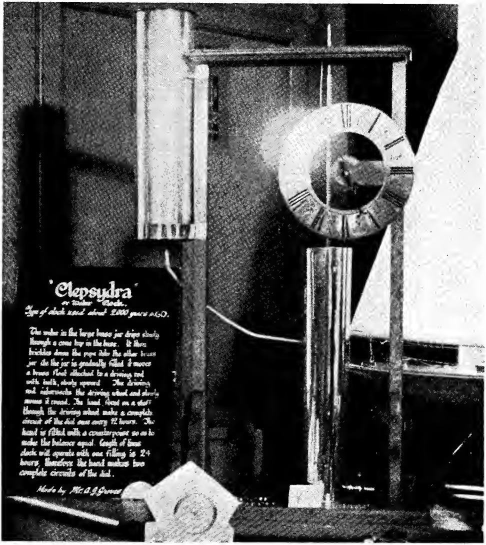
THE clepsydra shown was one of the many novel exhibits at the exhibition of model engineering, hobbies and handicrafts, held at Horsham recently.

This water clock, made of brass, keeps excellent time, and will run for 24 hours on one filling. Yet this type of clock was invented some 2,000 years ago!

Water from the large brass jar on the left, drips slowly through a cone tap in the base. It then trickles down the pipe into the other brass jar. As the jar is slowly filled, it lifts a brass float attached to a driving-rod with teeth. The driving-rod intersects the driving wheel and slowly moves it round, as the rod moves upwards.

The hand, fixed on a shaft through the driving wheel, makes a complete circuit of the dial every twelve hours. It is fitted with a counterpoise so as to make the balance equal.

It was made by Mr. A. J. Groves, of Springfield Crescent, Horsham, Sussex.



*A SIMPLE THREE-CYLINDER STEAM ENGINE

Incorporating a novel valve gear

By P. H. MORRISON

BRONZE rod should be used for the pistons, turned as in Fig. 10; the outside should be finished smooth with a rounded tool, to be a good sliding fit to the cylinders. It may be advisable to mark the respective cylinders and pistons 1, 2, 3, for mating on assembly. Do not economise on the depth of the packing groove, as the packing is more effective in a deep than a shallow groove. Make the gudgeon-pins a full 1/32 in. shorter than the piston diameter: use 3/32-in. silver steel, and make sure the pins are a tight fit in the pistons, otherwise the cylinders may become scored in use.

Sweat together three pieces of 3/32-in. bright mild steel as shown in Fig. 6, drill and file to shape the three pieces in block form, then heat up to separate, and clean up to finish. The little red bushes are next soldered in the eye of the connecting-rods (Fig. 6); the bushes must be an easy fit on the gudgeon-pins.

Eccentric and Spindle

Fig. 12 gives all the dimensions required to produce this simple item, the spindle is a piece of $\frac{3}{16}$-in. silver steel, and the eccentric is of brass rod; do not make the eccentricity less than the $\frac{1}{8}$-in. specified.

Bronze rod is used to make the valve from; the face should be lapped as described for the steam block, and the exhaust cavity must be an easy running-fit to the eccentric. (See Fig. 13.)

The steam-chest is constructed from thick brass tube 1-in. bore, the cover plate, together with the displacement lubricator, being soldered on the end of the tube. Drill the 1/32-in. diameter hole along the tube before the building up is started, and drill through into the lubricator afterwards. In order to keep the " bits " in their right places whilst soldering, fasten the lubricator tube to the cover plate with a short 6-B.A. csk. screw through the hole in the centre of plate. Place the tube on steam-block spigot, and lightly clamp the plate down on to tube with 6-B.A. screws into the steam block (these screws should be black-leaded in case the solder gets to them). No sizes are given for the lubricator, but examination of Fig. 1 and the photograph should provide enough guide to the construction, and also help to make the above assembly notes clearer; reference should be made also to Fig. 14.

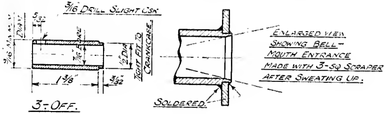


Fig. 7. Details of cylinders

The big-end bush is turned from bronze bar, an easy fit in the connecting-rod big-ends; the $\frac{3}{16}$-in. hole for the crankpin may be eased as for main bearing. It will be noted that the connecting-rod assembly is quite simple; the bush merely floats in the big-ends and there is only a slow " creepage " rotation of the bush within the latter, whilst the main rubbing occurs between the inside of bush and the crankpin within; it will be observed that there is ample bearing area in this arrangement. Make sure the hole in the bush is truly concentric with the outside diameter, otherwise the engine will have an apparently mysterious " beat " as the bush slowly creeps round inside the big-ends.

Fig. 11 shows the crankshaft; cut the silver steel long enough to allow ample thread lengths, which can be trimmed down after soldering into the web; the latter is a piece of $\frac{1}{8}$-in. thick bright mild steel, cut to the shape dimensioned.

Port Tubes

$\frac{3}{16}$-in. diameter brass tube is bent at 90 degrees over a $\frac{3}{8}$-in. diameter bar; the tubes are of different lengths, to suit the staggered position of the cylinders. Cut to length, so that each tube has a projection into the cylinder heads of $\frac{1}{8}$ in. and into the steam block $\frac{1}{16}$ in. bare, so that the tubes may be sprung into position later. Make sure the tube is annealed; a quick way to pack the tube for bending is to fill the inside with thin wires, which are withdrawn, one by one, after bending; this is a cleaner dodge than filling-up with lead or pitch.

* *Continued from page* 114, " *M.E.*," *January* 23, 1947.

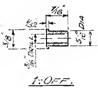


Fig. 8. Big-end bush

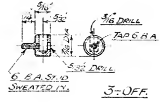


Fig. 9. Cylinder cap

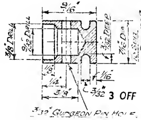


Fig. 10. Piston

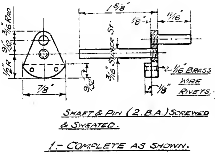


Fig. 11. Crankshaft

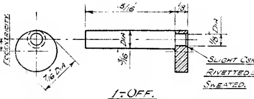


Fig. 12. Eccentric and spindle

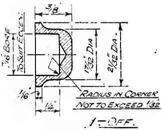


Fig. 13. Valve

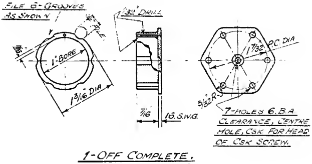


Fig. 14. Steam-chest and cover

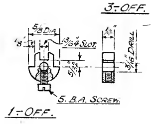


Fig. 15. Valve coupling

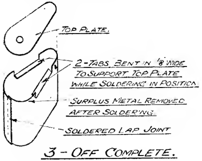


Fig. 16. Method of building-up lagging cases

Assembly

The cylinders are tightly spigoted into the $\frac{1}{2}$-in. holes in crankcase assembly, checked for squareness and sweated in position. Bell-mouth the cylinders afterwards, as indicated in Fig. 7. Screw the steam block on to the crankcase, insert the cylinder caps in position, then the port tubes, and solder the joints of these parts, the whole forming a very rigid structure. Now assemble the pistons to the connecting-rods, with the gudgeon-pins, and wind soft yarn in the packing grooves; do not pack too tightly. Place valve spindle in the steam block, then lightly fasten slotted coupling (see Fig. 15) to spindle. Insert each piston in its respective cylinder, bring the three big-ends of the connecting-rods into line, and place the big-end bush in them, following up with the crankshaft, allowing the end of crankpin to enter the slot in the valve coupling. After slipping main bearing, with back-plate, on to the crankshaft, secure the frames with six 6-B.A. screws. Next release the valve coupling, and set one piston to top dead centre; place the valve on the eccentric and rotate same until the valve has passed right over the port communicating with the cylinder selected, and is exposing 1/64-in. crack as it is about to uncover the port again. Tighten the set-screw in the valve coupling, and re-check the timing. Drill the side of the steam-chest, and tap, to receive a $\frac{3}{16}$-in. steam supply pipe, or a union for same, then assemble to the steam block, with a paper gasket around the spigot in the joint; 6-B.A. screws are used to fasten down the steam-chest. The engine may now be tested (with or without a flywheel) and assuming the test is satisfactory, the surplus solder can be trimmed off, and the cylinders and port tubes lagged by winding on asbestos string; it is worth while to make the tinplate lagging cases as shown by Fig. 16. These are held on by the 6-B.A. studs protruding out of the cylinder caps, and when fitted, create a clean outline to the engine. The writer's engine is painted with "Roscoe" cylinder black, the edges of the crankcase, back-plate, and steam-chest cover being left polished, and the effect looks quite business-like.

This engine has driven a metre hull quite briskly, with a reasonable boiler behind it; of course, a marvellous tick-over can be obtained when the regulator is throttled down, and an instantaneous response on opening same.

The above engine is the sort of model one can soon finish before the interest has a chance to flag, or before one of those "more important" jobs has time to rear up and swamp the good intention.

Woodworking Quiffs

By R. V. Worth

As one who has always been associated with woodwork, it occurred to me, that in many articles—especially on model ships—the writers assume the reader has a good knowledge of woodwork. In every trade it is the "quiffs" that make for easy working, and I hope the following may help a few, at least, of "our fraternity."

Do you know —

(1) When using plastic wood, if the knife blade is moistened with a damp rag, it will keep clean and impart a smooth finish?

(2) It is far better to tint the plastic wood with dry colour, to match the finished work than to have to "spot" it after drying?

(3) Iron filings mixed with plastic wood will make a super hard "stopping?"

(4) When using fine brass screws in hard wood it is advisable to bore a hole slightly smaller in diameter than the screw, for nearly full depth, or else the screw may shear off?

(5) A lot of modern glues (cement is a better name) contain resin and the hardener, especially, is best kept away from the skin, as it is harmful and can cause dermatitis?

(6) When planking a hull, if there is a fair distance between frames, and planks incline to "move," small copper wire dowels introduced in adjoining edges of planks will stiffen the whole assembly?

(7) It is better to procure a pointed iron rod slightly smaller in diameter than stern tube and use it to burn the hole through the hull? The rod direction can be governed effectively by guides. The same method is recommended for rudder tubes.

(8) A good packing for stern tubes can be made by mixing white lead and gold size formed into a stiff paste with cotton wool?

(9) If planking is marked with a line, say every inch on the inside surface—it is easy to check for true bending and shaping, as you proceed?

(10) If planks are to be of solid wood, it is advisable to plane a board to same thickness as plank width and "run" all the planks from it? You will then find all the planks bend similarly and so help to get both sides of hull alike.

(11) Soap is a good lubricant for wood screws, but it is easy to lubricate screws by placing a quantity in a tin with some oil and giving a good shake up?

(12) Quite a good "quick" finish can be produced by using French polish—(preferably "garnet") and dry colour mixed as a paint, lightly smoothing down and giving one coat of varnish? Thus painting and varnishing can be done in one evening, and is quite durable.

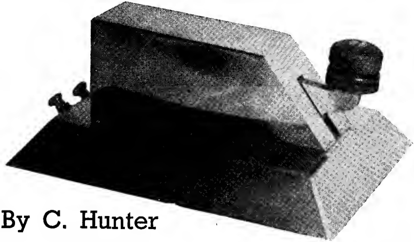
(13) That plastic sheet shrinks and swells if stuck to wood with hot adhesive, and so cold cements should be used if warping of finished work is to be avoided.

(14) A small try-square with a perspex blade is a very useful tool, and easily made? It allows visibility and will bend over gentle curves, such as hull sides or deck.

(15) Perspex can be cleaned and polished with metal polish?

(16) Some screws are deceptive and are "brassed" on iron, and so not suitable for our shipbuilding activities?

—··· MORSE KEY ···—



By C. Hunter

MY first aim in making this morse key was that it should not have any perceptible side movement, and yet be perfectly free to move up and down, also be more or less balanced; the result far exceeded my expectations. The gap and spring tension are each adjusted by the knurled screw and lock-nut and hex. nut seen immediately at the side (spring under base).

The general construction and action can be seen from the photographs, which show pretty well all that is needed.

A brief description will help to clarify any points about it, which will help anyone who might contemplate making one similar, as I had neither lathe nor vertical at that time.

Item 1, *Key.*—Part of 12-in. second cut file (flat). Item 2, *Key Stand.*—¼-in. × 1-in. mild-steel bar. Item 3, *Bearing.*—Bicycle spindle cones and 30 ⅛-in. balls.

Item 4, *Gap Adjustment.*—5/32-in. silver-steel, cheese-head screw (brass), with piece of hacksaw blade sweated on.

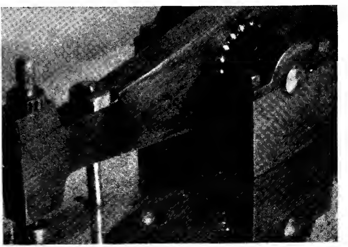
Item 5, *Stop and contact.*—Cheese-head screws (5/32-in.) screwed into key and filed off; 2 washers (washers and bush also on one terminal) and ¼-in. bush (5/32-in. hole) to insulate bottom screw (insulators, toothbrush handle).

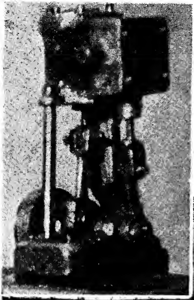
Item 6, *Handle.*—Part off leg of chair or table (top part of key being rounded and threaded, handle chiselled to fit square and bored to take bush screw).

Item 7, *Base.*—20-s.w.g. brass with ⅛-in. × 1½-in. stiffener, all soldered.

Item 8, *Cover.*—20-s.w.g. brass (principally to keep out dust).

The key was bored (after shaping) $\frac{5}{16}$ in. for spindle, counterbored with a shaped drill the size of the cones (this was the only part done on vertical machine: my best drill does not take the size of drill used); the rest of the drilling was done by hand. The cones and a full set of ⅛-in. balls were then put in place in the drilled recesses with a dose of carborundum paste—the breast drill chucked to spindle and the whole ground in. After cleaning up and fitting new set of balls I found the key working all right, the balls running in the grooves cut in the key by the grinding process; lock-nuts are fitted behind cones, the key being removable without the adjustment altering. The file was chosen to make a long-wearing bearing for the balls. *A warning*—I asked an old engineer about hardening. He said the key would probably crack across the hole, so I left well alone.



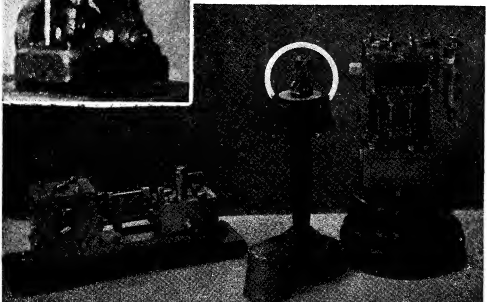


THREE MINIATURES

By

John E. King

(*Photographs by Mr. Bishop, Portsmouth Camera Club*)



THE DUPLEX FEED PUMP was made to stow on the running-board of a $2\frac{1}{2}$-in. gauge "Helen Long" locomotive. I found that it protruded over the side of the locomotive, which was not true practice. Hence I made up the horizontal Weir-type boiler feed-pump, which can be stowed conveniently on the running-board, and has proved very efficient when the locomotive is not running and stopped at station or siding.

Sizes of Duplex boiler feed-pump.—Cylinder bore, $\frac{3}{8}$ in. dia.; pump barrel, $\frac{1}{4}$ in. dia.; stroke, $\frac{5}{8}$ in.; pump double acting; steam ports, cross-over type.

Sizes of horizontal Weir type.—Cylinder bore, $\frac{3}{8}$ in. dia.; pump barrel, $\frac{1}{4}$ in. dia.; mechanically operated; piston valve, $\frac{1}{8}$ in. dia.; shuttle valve, $\frac{3}{16}$ in. dia.; stroke, $\frac{5}{8}$ in. Flat slide-valve to suit.

It will be noticed that there is no valve-cheat on the pump and that it is incorporated in the pump-barrel, necessitating two ports instead of the usual one at the end of the stroke, one to delivery and one to suction.

These pumps have worked efficiently for two-hour periods at 100 lb. per sq. in. on their own boiler.

I have been asked why I made the vertical double-acting steam engine. The Portsmouth Model Engineering Society, of which I am a founder-member, contemplated an exhibition of members' work. Having made up some parts for my wife's wrist-watch, the idea struck me that I could make a *working steam engine* to stow in a small thimble, which would prove a novelty and test out the patience and skill of anyone doing the same.

It proved a great success at our Portsmouth exhibition and was partly responsible for drawing 3,600 spectators, thereby swelling the funds of our club for workshop tools, etc. My special reason for making the engine was to induce others,

(*Continued on next page*)

A MODEL HARP

by L. Corder

I WONDERED if readers might be interested in the model I have just completed. It is of an Anglo-Celtic harp, about 1820. The original is in the Kelvin Grove Museum, Glasgow, where I was allowed to measure up.

The model, one-quarter actual size, is constructed in mahogany and brass, french-polished and gilded, with three hand-carved figures at the top of the fluted column, also hand-carved ornament and feet, at the base.

The photographs (commercially done) are not very good, but they may be just sharp enough for the detail to be seen.

Three Miniatures

(Continued from previous page)

especially the younger members, to follow suit of an old member (73 years old) to do *the same.*

How I Made It. First I made a freehand drawing actual size ; then I made the crank by comparison, and all other parts to follow the sketch by comparing each part. Column bottom covers are fabricated and hard-soldered ; other parts were soft-soldered, but very great care was taken in the assembling. This was one of the most difficult parts of the job. The slide-valve is made floating on a tiny shroud to allow it to come up to the slide face, also setting the valve-travel. The piston-rod has properly-formed shoe to work in the guide, otherwise you will notice it is a replica of the Stuart Turner vertical steam engine.

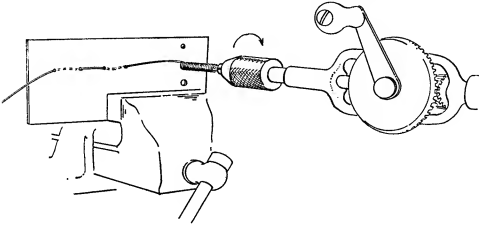
Sizes of Engine. Total height, $\frac{9}{16}$ in. ; cylinder, $\frac{1}{8}$ in. bore ; under air pressure, r.p.m., 1,200-1,500. The engine easily stows in a small thimble, and proved most interesting to model engineers. It will buzz like a bee when under air pressure.

WINDING SMALL SPRINGS

By B. C. Wood

THE following method of winding small springs may be of interest to readers. I have used it for a number of years after seeing a description in a handbook—Kempe, I believe—but it does not seem to be generally known.

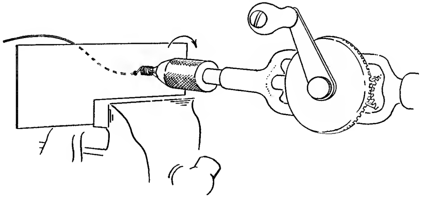
I. Tension Springs. A piece of ebonite or fibre is held in the vice and two sets of holes are drilled.



Those on the left serve to tension the wire which is threaded through alternately front and back; those on the right act as " bearings " for nails or suitable size mandrels held in hand drill chuck. The end of the wire is poked between the chuck jaws, and the nail is rotated, keeping the coil gently pressed against the ebonite as it is formed, i.e the hand drill is progressively pushed backwards towards the body.

II. Compression Springs. This method is almost uncanny in its action and produced hearty laughter the first time it was tried.

The same piece of ebonite may be used, a small hole for the wire being drilled 1/32 in. away from the edge of the " bearing " hole. The wire is fed through from the far side and into the chuck jaws. The spring is then wound up as before, taking care to keep the coil closely pressed against the ebonite. On releasing pressure, it will be found that the spring will separate its coils automatically.



A spring with internal diameter smaller than the mandrel will be produced if the wire is fed through a nick in the side of the bearing hole instead of through a separate hole. In a similar way a more open-spaced coil may be produced if a mandrel larger than finished spring size is used.

The spring ends are finished off " L.B.S.C.-wise " on a fast-running grinding wheel.

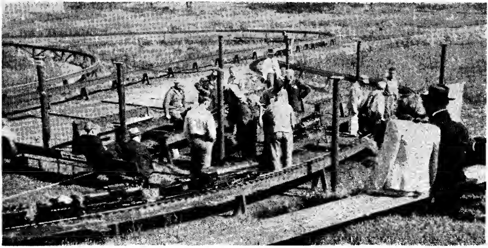
Something Like a Meeting!

By "L.B.S.C."

IT used to be a standing joke that if one wanted to see things done on the grand scale, they had to look across to America. Well, there's many a true word spoken in jest! Even in the world of little locomotives, the members of our fraternity on the other side of the big pond, certainly go "all out" in their undertakings. I have just received from Mr. C. A. Purinton, a batch of photographs and an account of the fourteenth annual meeting of the Brotherhood of Live Steamers, at Danvers, Mass., which puts the usual kind of club meeting completely in the shade. This meeting, called "international" because it was attended by members from over the Canadian border, lasted three days, and took place on October 4th, 5th and 6th, 1946. About 300 members from 28 states were present; and, in addition to the Canadian contingent, which came from Montreal, others came from as far afield as Coloiado, Florida, and California. The weather being fine during the whole of the three days, everybody had an enjoyable time; there were over fifty engines in steam altogether, and a number of unfinished jobs were on view in Mr. Lester Friend's "Yankee Machine Shop," which is close to the track.

Our worthy friends at Malden have a fine outdoor line, and there is another larger one being built at Campbell Green, Birmingham; but both these lines will be eclipsed by the track now being completed by the Brotherhood of Live Steamers. The "route mileage" at the present time consists of about 1,400 feet in two loops, but further extensions are in progress. A bridge, wide enough to take a farm tractor, is being built over a creek; and when this is completed, the line will be diverted from its present location, cross one side of the bridge, and proceed around a meadow, returning over the other side of the bridge to rejoin the present main line. I don't know the actual length of the extension; but it is a pretty safe bet that it will make the complete layout not only the longest miniature railroad in the world, but one that will hold that distinction for a considerable time. In addition to the running line, there are storage and roundhouse tracks, and a long siding connecting same to the main stem. Engines are moved from one track to another by a transfer table (we should call it a "traverser" in this country) and considering the size and weight of some of the Brotherhood's locomotives, this piece of apparatus serves a very useful purpose indeed!

The locomotives themselves are many and varied, ranging from huge Hudsons, Mikados, and Pacifics, to old-timers like Ed. Bergh's $3\frac{1}{2}$-in. gauge edition of Charlie Hogan's New York Central record-breaking 4-4-0, the famous "999." Other notable engines of an era now past, are an old Forney 0-4-4 tank, and a "Mother Hubbard" 4-4-2 with a cab perched on the middle of the boiler barrel. The locomotives are not all Transatlantic types, either; Carl Purinton's "Little Red Hen" was running, also Ed. Leaver's "Maisie," and Norman Robinson's "Fayette." The "Hen" is a variation of "Princess Marina," and the other two need no introduction to regular followers of these notes,



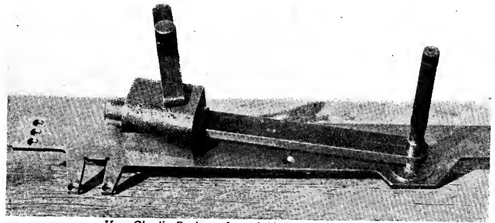
"The East Roundhouse"

as they were built to conform with "words and music."

Our good lady friend, Mrs. Austen-Walton, whose engine took an award at the recent MODEL ENGINEER Exhibition, will have to look to her laurels, for there are three active feminine members of the Brotherhood —or had we better call it the "Brother-and-Sisterhood" now? One of them, Mrs. Cecile Vachon, is building a Boston and Albany tank engine; and a photograph of her, turning the coupled wheels in her workshop, was published in the *Boston Daily Globe.* It reminded me of my munition girls at work during the 1914-1918 war; and knowing what experts they proved to be, both on bench and machine, I haven't the slightest doubt that our worthy sister's locomotive will be fully equal, both in appearance and performance, to any of the Brotherhood's "Live Steamers." In passing, I fancy that if we lived in less troubled and uncertain times, there would be some "surprises for the mere male" on this side of and the whole issue forwarded to me by air mail. That gesture certainly hit me in a soft spot! Well, as I remarked once before, I couldn't go "gadding around" for all the tea in China, confining my visiting to a few personal friends; but I like to reckon the above-mentioned parties in that category, also John Matthews, Doug. Massie, Ed. Leaver, Nelson Burtt, Ed. Bergh and the rest of the "signatories." That being so, nothing would have given me greater pleasure than to have taken "Jeanie Deans" to Danvers, joined in the fun, and tried her all out over the long line. I received the invitation all right; the only trouble was, that I couldn't put the locomotive in the back of the gasoline cart, as many other members of the Brotherhood did, and drive over, because there is a mighty big puddle of water in between, and the said gasoline cart has neither floats nor wings!

A Cylinder-Locating Wheeze

Carl's son, Charlie, having built a $3\frac{1}{2}$-in. gauge 0-4-0 switching locomotive, which does the job in good style, thought he would have a shot at another simple job, British this time, seeing that "pop" went British with the "Little Red Hen." He chose "Rainhill," and got busy; and wishing to locate his cylinders on the frames before erecting them, used the dodge that you see illustrated. It needs no explanation; as the old advertisement said, "the picture tells the story." It is impossible to get the cylinder out of alignment with the driving axle; and when the clamp is put on, as shown in the photograph, the stud holes in the bolting face of the cylinder can be located by putting a drill through the holes in the frame and making countersinks in the bolting face in the usual manner.

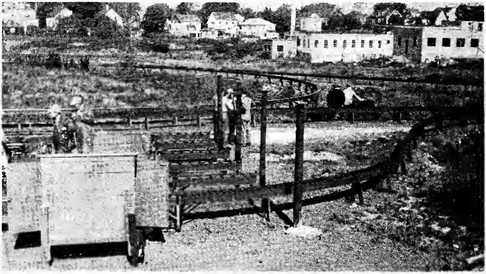


How Charlie Purinton located his "Rainhill" cylinders

the pond. The wife of a correspondent told me that if she only had available the time otherwise wasted in queuing, searching around the shops for necessaries, mending and making-do, trying to keep worn-out house furnishings respectable, and other "fruits of victory," she would love to build one of the graceful engines of fifty years ago. She has both the knowledge and skill; and the engine *would* be a beauty!

In conclusion, I would like to put on record just one little human touch which took place at the Danvers meeting; and I'm not ashamed to confess that a big lump came into my throat when I read it. Some of the older members of the Brotherhood got to talking about your humble servant, and Carl Purinton said, "Look what Old Curly started when he suggested a Brotherhood." Harry Sait chipped in, that it would have been fine if I could have been there to see it. Then somebody had an idea, and Bill Leggett wrote a little note of greeting which all the members of the "old gang" signed; their photographs were taken singly and in pairs,

Incidentally, one of my own cylinder-locating tricks is to use a dummy back cover with the register a perfect fit in the bore, and a sort of glorified long dummy piston-rod of straight silver-steel projecting from the gland boss. This is adjusted to pass exactly over the centre of the hole in the driving axlebox when in

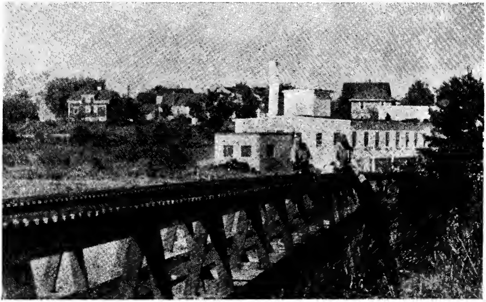


A transatlantic "Clapham Junction"

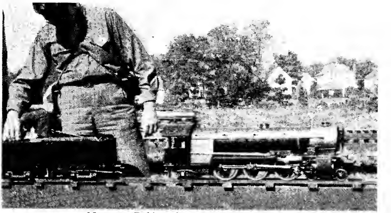
running position. The cylinder is then clamped temporarily to the frame, and the stud holes located as above.

Reversing Loose Eccentrics

Since my note about using loose eccentrics in "Juliet's" valve-gear appeared, several readers have written to point out that loose eccentrics can be reversed from the cab, by aid of a rack-and-pinion device, without any necessity for moving the engine. Quite true; I tried it many years ago. Instead of the loose eccentrics running directly on the axle, they were attached to a sleeve which was loose on the axle. This sleeve had a $\frac{1}{8}$-in. slot cut across it; and through this slot, a $\frac{1}{8}$-in. pin was screwed into the axle. When the axle revolved this pin came up against the end of the slot, and rotated the sleeve with the axle, in whichever direction the engine was moving. A small pinion was mounted on the sleeve, close to one of the eccentrics, and directly above this was a



"Set 'em alight, boys!"



Norman Robinson's 3½-in. gauge " Fayette "

rack, connected to a reach-rod extending to the cab. In the cab was a lever running freely in a plain quadrant, without any trigger, latch, and notches, and the reach-rod was attached to it below the fulcrum pin. The rack had a couple of teeth missing in the centre, so that the pinion could revolve freely when the rack was in mid-position without moving it ; and when the gap in the rack was over the pinion, the lever was in mid-position, where it was held by a light spring stop.

To reverse an ordinary loose-eccentric engine, with the usual stop collars and pins, it has to be pushed in the reverse direction, the eccentrics remaining stationary until the shoulder of the stop collar catches the pin. It is obvious, therefore, that in order to reverse with the engine stationary, the eccentrics must be turned in the opposite direction of rotation, until the pin comes up against the shoulder of the stop collar ; or, in the case of the slotted sleeve, until the opposite end of the slot comes up against the pin in the axle. To do this with the arrangement mentioned, all that was necessary to reverse from forward to back, was to pull the lever back as far as it would go. The reach rod being connected below the fulcrum of the lever, it was pushed forward, which moved the back half of the rack over the pinion, and turned the sleeve carrying the eccentrics in a forward direction until the end of the slot caught the stop pin in the axle. The eccentrics were then O.K. for the engine to " go astern," as our nautical friends would say. On opening the regulator, the axle, of course, turned backward, the stop pin driving the sleeve, and the moving pinion ran the rack backwards until it came to the gap in the middle ; the lever in the cab, operated by the reach-rod attached to the rack, returned to mid-position and was held there by the spring stop.

To go ahead again, the lever was pushed forward as far as it would go, pulling the reach-rod back, and enabling the front half of the rack to turn the pinion and sleeve backwards until the stop pin engaged with the other end of the slot, thus setting the eccentrics for forward running. As the engine started ahead, the pinion moved the rack forward again until it reached the gap, the lever in the cab once more returning to centre.

Not So Good !

Now this, like many other " designs," sounds fine, and is perfect on paper ; unlike many other " designs," it worked very well, yet in detail it was not so good. The trouble was, that the rack

The old Forney tank doing the job

and pinion had to be placed between the eccentrics, whilst the reach-rod was outside; and it required a bit of jerry-wangling to connect them up satisfactorily. It would have been easy to attach the lever to the inside of the frame, and connect the lower end of it to a reach-rod passing under the firebox direct to the rack arrangement; but this would have prevented the use of a dump grate and ashpan, so your humble servant schemed out a variation whereby the rack was dispensed with, and the pinion operated by a segment of gearwheel, something after the manner of a kick starter, as used on motor-cycles.

A Literal Reversing "Gear"

A segment of a small gear-wheel taken from a broken gramophone motor was fixed on a sort of weighbar shaft over the driving axle. The shaft was mounted same as an ordinary weighbar shaft, and had the usual reversing arm on the end. The segment of gear-wheel had the centre teeth filed out, same as the rack, and the remaining teeth geared with those of the pinion in the usual manner. The reach-rod went direct from the reverse arm to the cab lever, and this time was pivoted above the fulcrum pin. This was a better arrangement altogether, and no jerry-wangling of any sort was needed. The action was the same as the rack; to reverse the engine from forward to back, the lever was pulled back, which also pulled the reverse-arm back. The segment of gear-wheel, which hung down and, therefore, moved the opposite way to the reverse arm, moved forward and turned the eccentric sleeve forward until the end of the slot hit the stop pin, setting the eccentrics right for going backwards. When the engine moved, the pinion turned the segment of gear-wheel back to centre again, where it was held by the spring stop on the cab lever. Reversing from back to forward was the same operation the other way around, the lever being pushed forward, and the front half of the segment moving backwards and doing the needful to the pinion and sleeve; the lever returned to centre as soon as the engine moved.

Variation for Wheel-and-Screw

It was obviously impossible to use a wheel-and-screw to operate the reach-rod, as the nut on the screw could not automatically return to centre, in the same way as the lever; whilst the screw could drive the nut, the nut couldn't turn the screw. Well, your humble servant wouldn't be "done," so I schemed out another wangle, taking the idea this time from an ancient "postman's alarm clock" which I had repaired for a friend. The alarm releasing mechanism was connected to the hour wheel by a three-armed spider, so that it could be turned independently of the hour wheel, but at the same time the hour wheel could drive it by the friction between it and the arms of the spider. "Arms" of a spider sounds all wrong, but they were too wide to be called legs—I've never yet seen a spider with fat legs! Anyway, the sleeve, eccentrics, stop pin, and pinion were all exactly the same as the arrangement described above; but instead of the "weighbar shaft" carrying a segment of a gear-wheel, it had a complete wheel, and revolved the opposite way to the driving axle all the time the engine was running. Instead of a reversing arm on the end, a steel disc was fitted; and against this, was a small three-armed spider like the one on the clock' the arms pressing on the disc. On the other side of the spider, and connected to it, was a brass worm-wheel. Above this was a worm, the shaft of which was extended right back to the cab, where it ran in a small bearing on top of a stand like the ordinary reversing-gear stand; and the usual wheel, with handle in the rim, was fixed to the shaft beyond the bearing.

When the engine was running, the "weighbar shaft" revolved in the opposite direction, as mentioned above, and the friction disc on the end slipped around under the arms of the spider; the pressure of the latter on the disc was very light, and had no appreciable effect on the working of the engine. In fact, I should imagine the actual friction was less than that between the eccentric and strap of an eccentric-driven boiler feed-pump. To reverse the engine, all you had to do was to turn the reversing wheel a few revolutions. This actuated the worm-wheel and the spider attached to it; the spider, by virtue of the friction between its arms and the disc on the end of the "weighbar shaft," turned the latter, and the gear-wheel on it shifted the sleeve on the axle around until the pin came to the end of the slot. The engine was then all set to go in the opposite direction.

Objections Ruled Out!

Friends and relations of Inspector Meticulous will probably complain about the friction disc and spider being in contact all the time. I forestalled that by scheming out two simple devices, but they were never made, for the reason which will be mentioned at the end of this note. Scheme No. 1, dispensed with the friction disc and spider; in place of this was a simple dog-clutch worked by a little bell-crank which, in its turn, was operated by a piece of 16-gauge spoke-wire passing through the worm shaft, which was made from tube instead of rod. The clutch was out of engagement whilst the engine was running, and was only intended to be in mesh when actually reversing; a knob on the end of the wire, projecting through the reversing wheel, was pushed to engage, and pulled to disengage. Scheme No. 2, required only the worm-wheel on the end of the "weighbar shaft." By means of a bearing working in an inclined slot, the worm only engaged with the wheel during the actual reversing operation, and was normally held clear of the wheel, which revolved all the time the engine was running.

"Not Worth the Candle"

I guess many followers of these notes will wonder why I never specified in them any locomotives with a loose eccentric valve-gear reversed by a lever, or wheel-and-screw, as described above. Well, the explanation is perfectly simple; to quote one of granny's favourite sayings, "the game wasn't worth the candle." To make the most satisfactory of the loose eccentric lever reversers, you had to make lever, reach-rod, "weighbar shaft" with

(*Continued on page 174*)

*MILLING IN THE LATHE By "NED"

Section 6.—Indexing Gear

A general review of the principles, appliances and methods employed for adapting the lathe for various types of milling operations

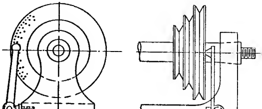


Fig. 48. *The form of divided headstock once common on instrument and ornamental lathes*

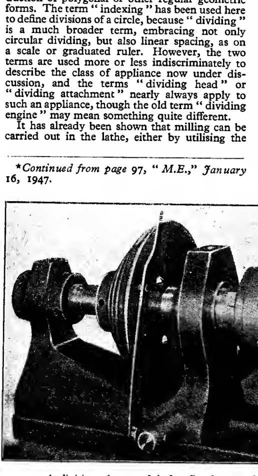
THE need for some means of circular dividing, or "indexing," is encountered in many kinds of milling operations, but more particularly in gearcutting, and the production of polygonal or other regular geometric forms. The term "indexing" has been used here to define divisions of a circle, because "dividing" is a much broader term, embracing not only circular dividing, but also linear spacing, as on a scale or graduated ruler. However, the two terms are used more or less indiscriminately to describe the class of appliance now under discussion, and the terms "dividing head" or "dividing attachment" nearly always apply to such an appliance, though the old term "dividing engine" may mean something quite different.

It has already been shown that milling can be carried out in the lathe, either by utilising the lathe mandrel as a cutter spindle or by using an independent cutter spindle. When indexing gear is used, it must obviously be applied to the work holding fixture in either case; that is to say, the former method calls for an indexing appliance fitted to the slide-rest of the lathe, and the latter, for some means of indexing the lathe mandrel itself. It will, perhaps, be appropriate to describe devices applied to the latter purpose first, because they are probably the more common, and are applicable to almost any lathe, with the minimum amount of trouble in fitting up; moreover, they can be employed for many other purposes besides milling.

The "divided headstock" fitted to many instrument, horological and ornamental lathes is perhaps the best known of these appliances. As seen in Fig. 48, it consists of a normal type of headstock, having the large step of the driving pulley drilled on the side or rim with one or more concentric circles of equally-spaced holes, and provided with a locking pin or detent attached to the fixed part of the headstock. In most cases, the number of holes in the circle, or circles, is designed to furnish multiples of the most commonly-used divisions. Thus, a circle of 60 holes will provide multiples of 2, 3, 4, 5, 6, 10, 12, 15, 20 and 30 divisions, which covers a wide range of general requirements, and is perhaps the most useful number to choose if one is limited to a single row of holes.

The locking pin in the example shown is mounted on a fairly stiff flat spring, attached at the lower end to a pillar screwed into the base of the headstock, so that

*Continued from page 97, "M.E.," January 16, 1947.



A division plate and index fitted to a plain lathe

the pin springs into the holes, and it is tapered to prevent backlash when in engagement. It is important also that the lower end of the spring should be firmly located so that it cannot move up or down. In some cases, a micrometer adjustment has been provided on the spring anchorage, so that it can be moved up or down by a definite amount, thus providing a " differential " adjustment, which enables divisions other than those covered by the number of holes, in the particular circle used, to be obtained. Generally speaking, however, an adjustment of this nature is difficult to use correctly, and may prove to be more trouble than it is worth.

In many lathes, the spring blade is replaced by a plunger which slides in a hole in the headstock pillar, and is sometimes provided with a spring, but more often is just a push-fit. This provides greater rigidity than the spring blade, but demands very careful fitting of the pin to avoid backlash. When any form of spring is used, some means of holding the pin out of action must be fitted, to enable the mandrel to rotate freely when normal lathe work is in progress. Spring plungers usually have a " bayonet " catch for this purpose, but in the case of a spring blade, it is usually only necessary to slacken the bolt at the lower end, and swing it away from the headstock pulley

The divided headstock can be used, in connection with a rotary-spindle milling attachment, for gear-cutting and similar operations, within the range of the divisions provided on the headstock pulley, but is at a disadvantage if some odd number of divisions is required. A much wider choice of divisions is possible by fitting a dividing appliance at the tail end of the mandrel, on which division plates or other available means of indexing may be fitted. In the case of screw-cutting lathes, any of the change wheels provided with the lathe may be used, or it is possible to mount any gear wheel or notched plate which may be obtained to suit the particular job in hand.

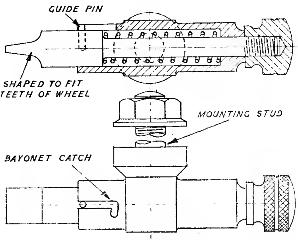


Fig. 50. *Simple indexing spring plunger for use with lathe change wheels*

It may be found difficult or impracticable to fit the dividing appliance on the tail end of the spindle owing to lack of space, or the presence of casings or other fittings over the end of the mandrel. Some of the older lathes are fitted with a thrust bearing on the end face of the mandrel which precludes any such fitting. But, in many cases, the problem may be solved by making a temporary extension to the mandrel, in the form of an expanding plug to fit the mandrel bore, and having a seating to carry the gear wheel beyond the end of the mandrel, as illustrated in Fig. 49.

Indirect fitting of the division plate, through a geared shaft, such as the tumbler reverse gear shaft, is not desirable, because of the inevitable backlash in the gearing ; but some workers have reported success with this method if great care is taken to take up play always in the same direction.

When using a gear wheel as a division plate the form of locking pin used with a holed plate is not usually suitable, though a pin shaped at the end to fit exactly between the teeth of the wheel can be used for light work. A better method is to use a plunger or detent having a broad bearing which will resist torque more effectively. Lathes having the usual slotted lug for the reversing pinion on the headstock casting, or a change-wheel quadrant with sufficient range to carry a locking device more or less level with the mandrel centre, may be fitted with the simple spring plunger shown in Fig. 50, the arrangement and use of which call for no explanation. Another very simple

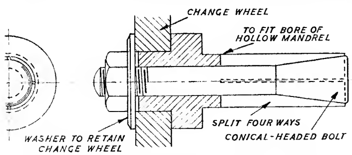
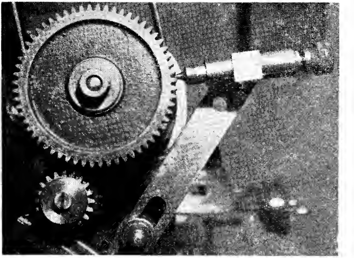


Fig. 49. *Expanding plug mandrel to carry change wheels on tail end of hollow mandrel*



The plug mandrel shown in Fig. 49, and the spring plunger shown in Fig. 50, in use on a Myford ML4 lathe

essential when using the worm for dividing. In some cases the worm shaft is spring-mounted, so that it is held firmly up against the worm wheel; apart from taking up play, this has the advantage of providing a quick-release movement, to allow of shifting the mandrel instantaneously when a large angle of rotation is required.

If a special worm wheel is used for the dividing appliance, the most convenient number of teeth is 60, but other numbers of teeth are often used, and, obviously, much depends upon the range of divisions obtainable at the worm shaft. The lathe change wheels may be used here also, but it is often found more convenient to fit a standard division plate, with a number of rows of holes, to give as wide a range of divisions as possible. Further refinements are the fitting of sector fingers to the division plate, to simplify counting of holes, and a thrust adjustment to eliminate any possible error through end play of the worm shaft.

It is sometimes possible to arrange worm dividing gear to engage with the large spur gear on the mandrel of a back-geared lathe, if the gear has a suitable number of teeth. This was done very neatly in the case of the Drummond 3½-in. lathe milling equipment illustrated on page 93 of the January 16th issue, the worm shaft being carried in a bracket which could be mounted on the headstock casting when required. Plain indexing has also been applied to the spur wheel, a notable example being that on the Eta lathe, in which the gear wheel had 60 teeth, but was made capable of providing 120 divisions by the ingenious device of using a plunger in which the engaging end was offset to the extent of ¼ the

locking device, which may be fitted in much the same position, is the eccentric disc illustrated in Fig. 51. The edge of the disc is turned to fit the space between the teeth of the change wheels; it is mounted on the square stud fitted to the quadrant or bracket, being simply pushed in to engage with the wheel teeth, and locked in position with the thumb screw.

Worm Dividing Appliances

The range of divisions obtainable from any indexing device may be enormously extended by the use of worm gearing, the increase being equal to the ratio of the worm reduction used. It is quite possible to use an ordinary spur gear, such as a change wheel, as a worm wheel, by screw-cutting a worm of suitable pitch to engage with it, as shown in Fig. 52. If possible, the shaft of the worm should be placed at such an angle that the worm tooth lies normal to the tooth of the change wheel when engaged, i.e., the worm shaft centre line should be at 90 degrees, plus or minus the pitch angle of the worm, to the mandrel axis. But this is not an absolutely essential condition to accurate dividing, as the object in this case is not mechanical efficiency or good wearing properties, but simply "wedge contact" between the tooth faces.

A worm gear can be adjusted to work with no backlash whatever, and this is

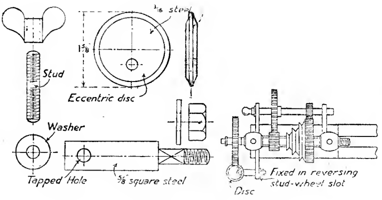


Fig. 51. Simple eccentric wedge disc indexing device

circumferential pitch. By turning the plunger through half a revolution, the spaces between the gear teeth could be split, and the range of divisions thereby doubled.

Accuracy of Indexing Gear

When indexing is carried out by dividing gear on the lathe mandrel, using a plain locking pin or detent, the accuracy of the finished work will depend on that of the division plate, assuming that backlash, spring or inadvertent movement of either the spindle or the lathe slides can be eliminated. The latter is the more difficult condition to ensure in practice. It is advisable to lock or clamp any movements not in use, and if the mandrel can be locked by any means which do not affect its rotational location, it is advisable to make use of this each time after setting the dividing gear, releasing it for shifting the mandrel. Side pressure exerted on the work during the cut may sometimes spring the locking pin out of its true position, or even force it out of engagement, unless this precaution is observed.

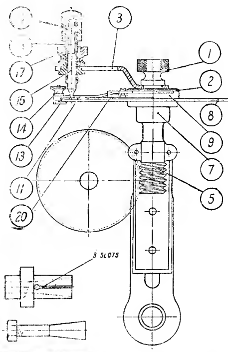
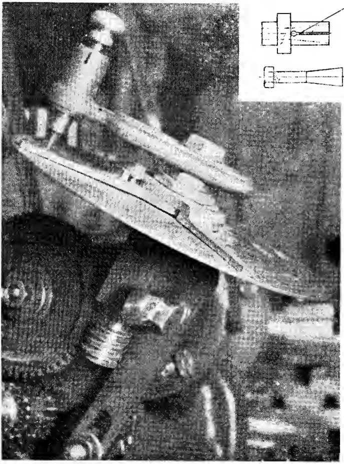


Fig. 52. Worm dividing gear as constructed by Mr. Ian Bradley

(1) Wormshaft hand nut, (2) sector plate, (3) index arm, (5) worm, (7) wormshaft bearing, (8) division plate, (9) clamping washer, (11) sector finger, (13) sector clamp, (14) clamp nut, (17) plunger housing, (18) plunger, (19) plunger knob, (20) sector joint. Expanding plug mandrel for change wheels also shown



Worm indexing gear as fitted by the writer to a Myford ML4 lathe

With worm indexing gear, the most important component in respect of accuracy is the worm wheel. Small errors in the spacing of holes or teeth in the division plate are of minor importance, as the effect of such errors is divided by the ratio of the worm reduction. It is thus possible to use improvised plates on a worm dividing appliance, and success has been obtained by using a plate spaced out with the aid of dividers for an emergency operation involving an odd number of divisions.

It may be mentioned that in most of the work encountered by the amateur, the use of the lathe change wheels gives sufficiently

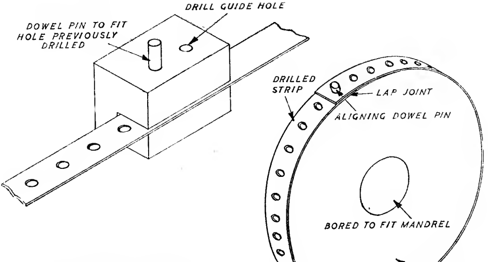


Fig. 53. Method of making an improvised division plate

accurate results, either for direct or worm indexing. In gear wheels generated by a hobbing process, errors are usually very small, as the method employed tends to even them out around the wheel; but some check on the accuracy of any device used for indexing is always advisable, if means are available for carrying it out. Specially made and tested division plates or worm wheels, however, are very expensive, and may be regarded as beyond the means of the amateur; they are only necessary for highly exacting work, such as on optical or other scientific instruments.

Making Division Plates

Many amateurs have attempted, with more or less success, to make their own division plates, and methods of doing so have often been described in THE MODEL ENGINEER. These methods need not be discussed in detail, but it may be mentioned that one of the best-known methods of generating a division plate by first principles is to drill a number of holes in a strip of metal, using a simple drilling jig to ensure equal spacing, as shown in Fig. 53, and bend the strip into a circle embracing the required number of holes. Join the ends, fitting a dowel or rivet to align the end holes, and then turn a wood or metal disc to such a diameter that the ring will just fit tightly over it, but without stretching or straining the joint. The distance between any two holes will then represent a definite and equal fraction of the circle. This method is applicable to any number of divisions, and may be found useful when some unusual number is required.

(*To be continued*)

"L.B.S.C."

(*Continued from page* 169)

reverse-arm and segment of gear attached to it, bearings for same, slotted sleeve with two eccentrics and pinion attached, and stop pin in axle. For a link motion, you also needed lever, reach-rod, weighbar shaft with reverse-arm, and lifting arms and links instead of the segment of gear-wheel. Two extra eccentrics, plus straps and rods, took the place of the sleeve and pinion; and two slotted links were needed to connect the fore and back-gear eccentric-rods. I found that making and fitting the parts of the link-motion actually took less time than fooling around with the slotted sleeve and the gear-wheels, and parts thereof; and with the link-motion you could notch up, which was, of course, not possible with the loose eccentrics. Also, a "pole" lever or a wheel-and-screw could be used without alteration to the gear. There is no need to reverse a loose-eccentric engine on a continuous road; and even if there were, I don't see any objection to pushing her half a turn. Maybe you don't push a big engine to reverse her (but it *has* been done!); well, neither do you carry her to the track in your arms, nor fill the tender or tanks with a water-can or jug, nor blow up the fire with a tyre-pump!

Thank You!

I am writing this on Christmas Day, dull and miserable as far as weather is concerned; but have just received the last of hundreds of friendly greetings from "Live Steamers" all over the world. It is a physical impossibility to send a direct reply to all, so may I take this opportunity of conveying most sincere and heartfelt thanks to the brothers and sisters of our fraternity for their good wishes. "Same to you, and many of 'em!"

* *Stephenson's Link Motion*
and Some Important Considerations
By R. W. Dunn

We will now again revert to the position of the eccentric when the stroke of same has to be made more than the travel of the valve, as when locomotive-type links are employed, as in Fig. 1 and 3. This increased throw is due, of course, to the eccentric-rod drive being out of line with the centre line of the valve spindle when in full gear. In Fig. 7 this arrangement is shown, and requires to be set out to scale to suit the requirements to a fairly large size. Suppose we have obtained our required valve events, as in the example Zeuner diagram, Fig. 4, and we have designed the links so as to make the angle ø, $7\frac{1}{2}°$, which subtends from the axis to the two points M, and N, where the centre of the die-block is located, as in Fig. 7. We then have to fix the minimum distance LM and NO for the centre of the eccentric-rod pins, so as to bring the die-block as near to them as possible. Having done this, we can arrive at the point C, as at Fig. 4, which has been already explained, for the maximum valve travel at mid-gear. This now allows us to ascertain the point Y, the actual eccentric position, as it will lie on a continuation of the characteristic curve radius. The formula for arriving at this radius, R, is given by the following :—

$$R = \frac{0.7 \times (AC \times AL)}{LX}$$

Finally, to obtain the position of Y on this radius, is just a matter of proportion, and we have YA : AC : LM : MX, so that :—

$$YA = \frac{AC \times LM.}{MX}$$

Having, therefore, found the point Y distant from A, all we have to do is to describe a circle through the point Y from the centre, and the resulting circle will be the path of the required eccentric centres, which, as will be found, is often considerably more than the valve travel. The other point Z, of course, follows similarly for the backward eccentric centre.

Launch Links

It may now be pointed out that the use of "launch" links does not involve the above considerations of increased eccentric throw, for the eccentric pin attachment to the link can be made immediately in line with the centre of the die-block ; in which case, the angle of advance and stroke of the eccentrics will be the same as that given on the Zeuner diagram, whereas both the angle of advance and stroke of the eccentrics in the case of locomotive links are quite different from the corresponding points given by the Zeuner diagram. The launch-type link is depicted in Fig. 6, and a very good type it is to use on small locomotives, especially with centre suspension ; but this will be referred to later. With regard to the Zeuner diagram in

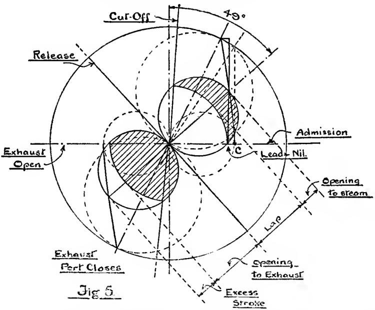


Fig. 5

*Continued from page 141, "M.E.," January 23, 1947.

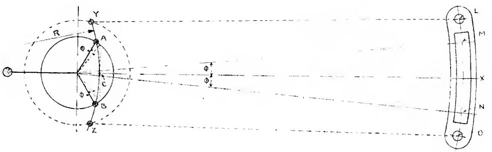


Fig 7 Radius R = $7\left(\frac{AC \times AL}{LX}\right)$

Fig. 4, it was thought that it may interest readers to see what effect would take place on this same valve setting when the gear was put at half link, that is the gear lever in the notch half-way between full and mid-gear. The result is seen in Fig. 5. The first thing noticeable is the much earlier cut-off and the shorter valve travel, being only two-thirds of full gear. Then the angle of advance increases from 26° to 49° at this link, while the opening to steam is only just over one-third of the full-gear opening. It will be noticed, however, that the exhaust is much more liberally treated, as it has the same opening, but the duration is not so long. Another point of interest is that, although we started with negative lead at full gear, on linking up, this lead changes to positive lead after passing the half-link notch. This is clearly seen in Fig. 5, where the characteristic curve crosses the perpendicular, as shown; it changes from negative lead, at full gear, to nothing at half link (as drawn), and then to positive lead at mid-gear. It is considered by the writer that the diagrams, Figs. 4 and 5, constitute an ideal valve setting for any locomotive from 2½-in. gauge upwards, and if the instructions for drawing out the valve diagrams are applied to the reader's own case he should have no difficulty in *knowing* exactly what to expect from his locomotive, as far as tractive effort is concerned, or enable him to make corrections to an unsatisfactory existing valve setting.

Link Suspension

A few remarks on this matter may be profitable, because, among other things, an unsuitable position of the fulcrum for the bell-crank, is likely to give most unsatisfactory results in the working of the valve-gear. When the locomotive-type link depicted in Fig. 1 is suspended at one end as shown, considerable die slip will occur when the die-block is at the end of the link remote from the drag-link attachment, whilst the nearer the die-block is to the suspension point, the less will be the slip. Consequently, express locomotives always have their forward gear eccentric-rod attached to the end of the link nearest to the point of suspension, so as to obtain the least die-block slip as in normal forward running. To equalise die-block slip, the alternative is to employ the centrally suspended links as shown in Fig. 8, the one on the left being the launch-type, and that on the right, the locomotive-type link, and in these cases the slip is about the same whether in forward gear or backward gear. Therefore, in model tank

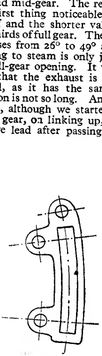


Fig 6.

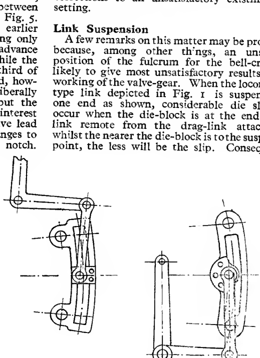


Fig 8.

engines, which run as much backwards as forwards, it is advisable to fit the launch-type links. In fact, for models generally, it is recommended that launch-links, with centre suspension is the most desirable type to fit, because, in the great majority of cases, engines are required to work almost as much in one direction as the other. It should be pointed out, however, that if it is desired to adopt mainly forward gear running, then to obtain the least possible die-block slip, the link shown in Fig. 6 should be adopted, with the forward gear eccentric-rod working at the top of the link.

Further advantages in the use of launch-links are that they have a shorter overall length than locomotive type links, which is beneficial sometimes in the restricted space beneath a low-pitched boiler; then, the eccentric-rod drive is in direct line with the valve spindle, and there is no need to have a greater eccentric throw than the valve travel requires. Now with regard to the location of the crank fulcrum, it is necessary to proceed in the following way to obtain this, in the case of either type of link. First, trace out on paper the path of *the point of the link suspension*, when the forward eccentric-rod is at full gear, during one complete revolution of the crank. Then, with compasses set to the centres of the proposed drag-link, which should be as long as possible, strike an arc from some centre immediately above or below the curved link (as most suited to the conditions) to bisect as near as possible the plotted irregular area so obtained from the forward gear. Again, the same procedure is adopted when the rod is in backward gear, the same suspension point tracing out a further irregular figure, through which we can get the second centre as before. The two centres thus obtained will determine the path that the end of the bell-crank will have to follow, and from which the desired fulcrum of the bell-crank may then be found.

Summary

Finally, we will summarise the foregoing in order of sequence for obtaining a check on our valve events :—

(1) Decide on the full-gear cut-off, also lead, exhaust lap, inside lead (if any).

(2) If locomotive-type links are to be employed, it is necessary to determine the position and throw of the eccentrics, which differ from the angle ϕ° therefore :—

(3) Construct the valve diagram for the required valve events as explained and shown in Fig. 4, making the valve circle diameter at least 0.4 of the cylinder bore.

(4) For launch-links, the stroke of the eccentric will be the same as the valve circle and the advance as given by the angle ϕ°; but for locomotive-links, the angle ϕ° must be found, from the inclination of the eccentric-rods, and this angle is then added to the angle of advance on the diagram from which the point C is obtained to enable the valve characteristic to be found, the continuation of which will allow the new eccentric centres to be ascertained by following out the diagram in Fig. 7.

(5) The mid-gear valve stroke in both cases is given by the point C, so that any cut-off can be predetermined for any required position of notching-up of the gear lever, from the gear characteristic curve, extending from the point C to full gear.

It is hoped that the detailed information given on these more remote facts concerning Stephenson's gear, correct suspension, and valve diagrams, which appears to have received little attention from readers of this journal, may be of assistance to those to understand more clearly valve events from the point of view of a properly-constructed diagram, and so allow an ideal valve-setting to be worked out to meet the reader's own particular case.

"Finish" on Small Locomotives

MAY I offer the following brief comments on Mr. Burdett's letter in your January 9th issue?

His remarks about "aesthetic sense" and "style" are much to the point. When one goes around exhibitions regularly one gets to know the work of certain people almost infallibly by its "style," and the possession of this aesthetic sense, and sense of style in itself will save the model maker from many of the pitfalls mentioned in the article to which Mr. Burdett refers.

It will certainly prevent the coarse-contoured chimneys and domes, which disfigure so many otherwise good model locomotives.

With regard to polish and plating, I realise that in special cases this *is* done in full-size practice, and where the model represents, say "Silver Jubilee," it is not only justified, but necessary, in the interests of realism; but such engines as "Cock of the North" and "Silver Jubilee" are most unusual exceptions, and the polishing of wheel rims and the plating of lagging bands and cylinder cover caps *is* out of place in the vast majority of model locomotives.

From my point of view, it would only be justifiable, in the case of a pure "free lance" model, if the entrant intended the engine to represent something suitable to draw the Royal Train, or for some similar purpose, and not only stated this fact on his entry form, but produced a model which in other respects was suitable for such a purpose.

What I had in mind was that high polish and plating on the average model locomotives are completely out of place; there are, of course, exceptions to almost every rule and Mr. Burdett has very usefully called attention to two of these. Only last week I saw "Silver Jubilee" at Chalk Farm, with her cylinder covers shining like a brass button on a chimney-sweep's pants.

In conclusion, may I thank Mr. Burdett for his interesting and constructive letter, and express my agreement with the sentiment which he expresses in his concluding paragraph, which, as I interpret it, is that a job worth doing is worth doing well, and well done is a permanent source of pleasure.—"THE WRITER OF THE ARTICLE."

Letters

Electrical Timing Apparatus

DEAR SIR,—Having completed a certain amount of experimenting with electrical timing, I was most interested in the description of the one constructed by Mr. L. P. Purple and his friends.

Although the timer they built differs somewhat from the one I made, I note they struck similar snags. The over-running of the ratchet wheel was entirely eliminated by employing a ratchet mechanism similar to that used in a "Synchronome" electric clock. For this idea, and other practical assistance at various times, I am indebted to Mr. Westbury, who can almost always be relied upon to produce ideas to cope with the most difficult problem.

My original timer, as described in THE MODEL ENGINEER No. 2287 in 1945, operated quite successfully on 6 volts, but the present one uses two small N.I.F.E. accumulators, giving a total of approximately 5 volts, which has proved ample. Instead of relying on what almost amounts to the brute force of 16 volts, may I suggest that Mr. Purple experiments with a solenoid instead of the electro-magnet fitted in his set, as I feel sure more power can obtained in that manner.

In timing model racing cars at over 70 m.p.h., my own electric timer has given every satisfaction, and I would like to point out that the laps are being completed at the rate of 15 every 12 seconds, which is rather more quickly than those of a model hydroplane on its normal circuit. As Mr. Purple mentions, the necessary electrical impulse time is easily arranged by extending the contact segment on the pole.

As the photograph below shows, my timer is still housed in its old micrometer box, measuring 4 in. × 8 in. × 1¼ in., and, *including* the batteries, weighs but 2½ lb., making it a truly "pocket" affair.

It can now be set to count *any* number of laps up to 60, and an automatic cut-out is arranged to switch off the current as soon as the required number of laps have been completed.

A full description of this set in its present form is being prepared for THE MODEL ENGINEER'S young brother, *The Model Car News.*

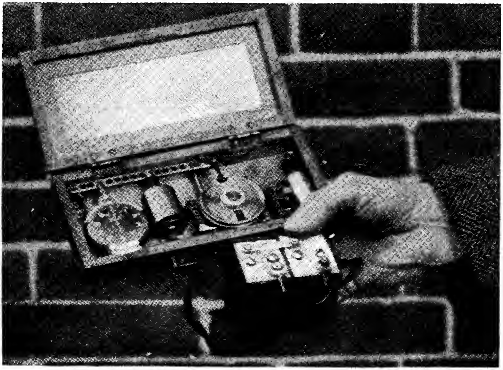
Yours faithfully,

Stoke-on-Trent. F. G. BUCK.

Overhead Gear for Milling

DEAR SIR,—I was very glad to see that in a recent issue of THE MODEL ENGINEER "Ned" recommended that the jockey pulleys of the "overhead," illustrated, might be given semi-circular instead of "vee" grooves. I made up this overhead about fifteen years ago, following MODEL ENGINEER Handbook No. 41 exactly. Continual trouble from belt riding off the jockeys —unless enormous counterweights were used— soon led me to round-bottom the jockey pulleys.

The same trouble pointed to another weakness of the design, which is the over-simplification of the fulcrum device. By inclining this forward—



that is setting it so that the pivot is not vertically above the tubular member which carries it—it is possible to ensure that the counterpoise arm does not jump through a large angle if the belt rides off. This, however, and even an ordinarily secure fixing in the vertical position, entails that the set screw by which this pivot casting is fixed should be tightened to such an extent that deep indentations are made by the point of the screw. If this set screw is not well tightened, one may have the experience—I have—of the counter-weight dive-bombing the paraphernalia behind the lathe, or (I've had this also) if the ceiling is low, the pulley end of the arm sending a shower of plaster down on the operator and into the" works."

A distinct improvement would be fixing by splitting the casting underneath, with pinching screw through a suitable lug; also forward inclination of the pivot arm and a flat or " stop " for the counterpoise arm (both provided as part of the design).

If space permits, the back end of the counter-poise arm can, with benefit, be made much longer than shown in your illustration, the extra leverage so obtainable obviating the need of hanging all the spare castings in the workshop on the arm as counterweight.

As to method of mounting the overhead shaft, much the best scheme is the late Kenneth H. Crabb's improvement (Vol. 84, page. 198) of my own arrangement (Vol. 83, page 167), especially if—as I have suggested—this shaft is made to serve as a second and high-speed countershaft for the lathe and means of driving other high-speed tools.

Yours faithfully,

Dublin. NIALL MACNEILL.

Clubs

Southampton and District Model Engineering Society

The annual general meeting of the above society was held at the Club Room, Prospect House, Prospect Place, Southampton, on Thursday, January 2nd, 1947.

Officers were elected for the new session. Mr. A. Martin was elected as the new hon. secretary, with Mr. F. Marsh acting in the assistant capacity.

A general tone of great enthusiasm was evident, which should bear fruit in 1947.

Will any person desiring to join please contact the hon. secretary. Whatever your interest in model engineering, you will find a kindred taste, ready to swap ideas.

How about it lone hands? Just drop a line to:

Hon. Secretary: A. MARTIN, 49, Grantham Close, Hamble, Hants.

Exeter and District Model Engineers' Society

The annual general meeting of the above society was held on January 4th, 1947, when officials were elected.

The society has been reformed fifteen months, and is going strong. Bad weather has retarded progress on the " track," but it is hoped to have this completed by the summer, when an official opening will be followed by a dinner and social evening.

Hon. Secretary: LESLIE J. OLDRIDGE, 38, Broadway, Exeter.

Kodak Society of Experimental Engineers and Craftsmen

On Thursday, December 12th, we wound up the first half of the winter programme with a social evening in the supervisors' dining room.

The programme started with a short comic film featuring Charlie Chaplin, after which we were to enjoy nearly an hour's variety entertainment, arranged for us by Mr. Jack Brittain. Refreshments followed, and then the evening concluded with a humorous " quiz " arranged by Messrs. Harris and Snook. They didn't have it all their own way though—our guests being able to " dig " up some equally " awkward ones."

Our thanks are due to all those who contributed towards the success of the evening; and especially to Miss Smith for providing such excellent refreshments, and to Mr. Jack Brittain for arranging the variety show.

Hon. Secretary: C. R. L. COLES, The Works, Wealdstone, Harrow.

Godalming and District Society of Model Engineers

Will members please note Sunday, February 2nd, as the date of our general meeting, at 3.0 p.m., at the Broadwater Hotel, Meadrow, Farncombe.

Hon. Secretary: J. BOURREL, Surrey House Cranleigh.

Kimberley and District Model Engineering Society

Continued interest is reported in the above society, whose last meeting was held in the evening of January 1st, and several new members are expected at the next meeting.

The main business of the meeting was to map out a programme for 1947 for the members, all of whom were pleased to learn that arrangements have been made for them to visit two local engineering firms, as well as the Cinderhill Colliery of The National Coal Board.

In addition, they will, when dates are fixed, be able to visit Colwick Loco., L.N.E.R., and Stanton Ironworks (Machine Shop), whilst it is anticipated a visit will be arranged to the North Wilford Power Station.

Two unfinished models (one a scale model of " The Flying Scotsman ") were viewed and discussed, greatly to the interest of those present.

It is hoped to hold an exhibition of members' models, unfinished and finished, later in the year, and so further stimulate interest, and enrol new members.

Meetings are held at The Horse and Groom, High Street, Kimberley, on the first Wednesday of every month, when, it is emphasised, new members will be made most welcome.

Hon. Secretary: W. T. PEDLEY, 11, Alandene Avenue, Watnall, Nottingham.